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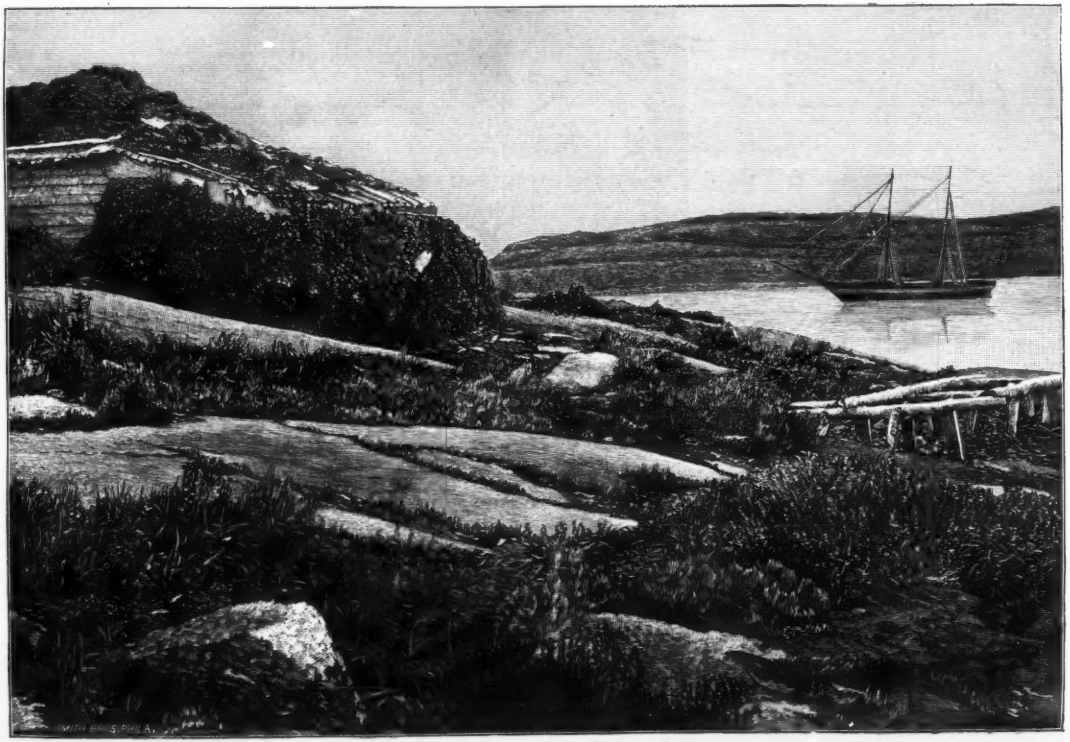

GLACIAL PLANING IN LABRADOR.

THE

AMERICAN NATURALIST.

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THE BLIND CAVE FISHES AND THEIR ALLIES.

BY S. A. FORBES.

AN unusual interest attaches to everything relating to the blind fishes of the caves, partly because of their peculiar deprivation and the compensation for it afforded by the development of special sensory structures more useful to them in their subterranean situation than eyes would be, and partly because the origin of their peculiarities has proved an inviting subject of speculation and discussion with reference to the doctrine of natural selection. In the careful papers of Mr. F. W. Putnam,[1] especially, we find accurate descriptions of the genera and species, and a clear statement of opposing views respecting the derivation of these little fishes.

A strict evolutionist passes, perhaps too easily, from the idea of the unbroken, rayless night in which the blind fishes live and seem to have lived for ages, to that of their atrophied eyes and highly developed epidermal organs of sense—connecting these at once as cause and effect on the strength of his general theory. In papers written, one nine and the other seven years ago, Mr. Putnam presented, partly in criticism of previously published explanations of Mr. Cope,[2] facts and considerations which seemed to him to break the force of the argument based by evolutionists upon the peculiar adaptation of the blind fishes to their surroundings, and even to compel the conclusion that the darkness of their situ-

[1] AMERICAN NATURALIST, January, 1872. Annual Report of the Peabody Academy of Science for 1871. Proceedings of the Boston Society of Natural History, Vol. XVII, 1874, pp. 222–225.

[2] Ann. Mag. Nat. Hist., Nov., 1871.

ation did not bring about the atrophy of their eyes, the development of their special organs of sense, or the bleaching of their skins.

The discussion seems not to have been carried further; and I now revive the subject because the study of a new species closely allied to the blind fishes, which has recently been discovered in Illinois, enables me to contribute a few facts which throw additional light upon it.

In the papers cited, it is argued, in brief, that the conclusions as to adaptation based upon the absence of functional eyes and the extraordinary development of tactile organs in Amblyopsis and Typhlichthys are negatived by the fact that in Chologaster, an equally subterranean genus, tactile organs are wanting, and eyes are fully developed. If genera without eyes, and another genus with them, are found living under the same conditions, the inference is obvious that the conditions cannot have caused this difference.

The possible rejoinder that Chologaster may still retain its eyes because it has had a shorter subterranean history, and has not yet become so thoroughly adapted to cave life as its predecessors, is forestalled by the argument that we have no right to assume that Chologaster is a later inhabitant of underground retreats than the blind fishes, until at least one specimen of the former has been found in the outer waters in the vicinity of the caves. The same reasoning is applied to the difference of color—Amblyopsis being colorless and Chologaster brown.

On page 232 of the NATURALIST for March, 1881, I briefly described a single specimen of Chologaster obtained by Mr. F. S. Earle from a spring in Southern Illinois; but did not undertake to decide, from a single example, whether it belonged to a distinct species or not. Seven additional specimens obtained by the same gentleman from the same place, agree so closely with the one previously found that it is evident that all belong to one species, and I have no longer any doubt that this is distinct from the two previously described.[1]

[1] *Chologaster papilliferus*, n. s. The head is broad and flat, contained three and a-half times in the body (without caudal), widest posteriorly and broadly rounded in front. Its width between the eyes is half its length. The eye is contained about six times in the length of the head, and is placed above and behind the tip of the maxillaries. The greatest depth of the body is contained five times in its length to caudal. The pectoral fins reach only half way to the anal; and the caudal is broadly

The most important and interesting peculiarity of this species indicates a more advanced stage of adaptation to a subterranean life than that of its congeners. On all the surfaces of the head appear short rows of peculiar tubercles, relatively wider than the papillæ of Amblyopsis, but also apparently shorter. They are much the largest about the anterior nostril and on the lower jaw, and are larger on the side of the head than on its upper surface. While the papillæ of Amblyopsis are set on ridges of the skin, those of this Chologaster are somewhat sunken within it, and often placed in grooves; and it is not until they are freed from the adjacent epidermis by dissection, that their full height is seen. When thus exposed they closely resemble the papillæ of Amblyopsis in form and size, and are similarly cupped at the tip. Aver-

rounded and almost truncate. The color is brown above, paler below, with three narrow longitudinal stripes, the upper and lower black, the middle one pale with narrow black edging above and below. With a glass the ground color is seen to be everywhere minutely mottled black and white. The fins are all nearly or quite concolorous, except the caudal, which is minutely marked with rows of white specks on a dusky ground. These specks indicate the articulations of the fin rays. There is usually a dusky vertical bar at base of tail. The dorsal and anal fins are thick and fleshy, their height about equal to their length, the former with six and the latter with five rays.

On all surfaces of the head, peculiar tubercles or papillæ occur in short rows, much the largest on the lower jaw and about the anterior nostril, where they are sunken in grooves of the skin. They are also larger on the side of the head than above. An irregular double row surrounds the anterior nostril, except externally, and behind this appear four short, transverse rows on each side, the last of these being a little behind and within the eye. Then follow about eight short, irregularly placed, oblique and transverse rows, accompanied posteriorly by a longitudinal row. On each side of the middle of the back part of the head is a short longitudinal row, each with a small patch not far from its tip. At the upper end of the gill-slit is a conical tubercle with an apical perforation; and traces of a series of vertical rows of tubercles appear on the anterior part of the side of the body. The side of the head bears many short vertical rows, with some longitudinal and oblique rows also. On the under side of the lower jaw, a double or triple row of large papillæ is set in a groove just within the jaw, and a small, triangular, sunken patch is found a little within the anterior end of this row. Another longer row of smaller papillæ runs parallel to the former, between it and the hyoid arch. Average specimens measure 37mm. in total length.

This species presents the internal characters of the genus, as defined by Mr. Putnam in his "Synopsis of the family Heteropygii," published in the Annual Report of the Peabody Academy of Science for the year 1871. The description of the genus should be amended, however, by the omission of the statement concerning papillary ridges and an opercular papilla.

Taken from a spring at the base of a limestone bluff, in Union county, in Southern Illinois.

age examples from the largest sub-maxillary row measured .01 in height by half that width. I found no projecting filament, however, in any of the cups, such as is described and figured by Professor Wyman in the papers of Mr. Putnam already cited. The interior structure of the papillæ also differs greatly from that of Amblyopsis, as the latter is represented by Professor Wyman. In Amblyopsis, according to that eminent anatomist, each papilla is supplied with a nerve fiber which terminates in a short, flexible filament springing from the middle of the concavity in the tip of the papilla. In the Chologaster each papilla is likewise penetrated by a nerve fiber, which is very easily traced, even without the help of reägents, because of the black pigment in the neurilemma, but this nerve passes to an epidermal "end organ" precisely similar in structure to those minute bodies found abundantly embedded in the skin of the head of young fishes, and belonging to the same general class as those sensory structures which occupy the lateral line.

This "end organ," or "nerve button," which fills the interior of the distal third or half of the papilla, is a nearly globular mass of cells, partly various modifications of the columnar, and partly spindle-shaped or spherical, each of the latter with a filamentous prolongation at one or both ends. The nerve fiber of the papilla passes, without division, to the inner end of the cell-cluster, where its fibrils appear to continue into the filamentous processes of the cells. Having no fresh material for the osmic acid treatment, I could not positively demonstrate the terminations of the fibrils. These are evidently simple examples of that class of structures to which a supposed "sixth sense" of fishes and amphibians has been assigned, and by which these animals are believed to appreciate motions of the water and wave lengths longer than those of sound.

The importance of well developed structures of this character to fishes without the use of the sense of sight, is very manifest. The close general resemblance between these organs and those described for the blind fishes, taken in connection with their similar situation, arrangement and apparent use, is probably sufficient evidence that the two kinds are homologous.[1]

[1] Is it not possible that the specimens of Amblyopsis studied by Professor Wyman were not perfectly preserved, and had lost more or less of their superficial epithelium, and with this the "nerve buttons" from the tips of their papillæ? Some color

Recurring now to the argument of Mr. Putnam, we note that the discovery of a species of Chologaster which frequents external waters of an immediately subterranean origin, supplies all needed proof that the genus either has a shorter subterranean history than Amblyopsis, or, at any rate, has remained less closely confined to subterranean situations; and that in either case the occurrence of eyes, partial absence of sensory papillæ and persistence of color, are thus accounted for consistently with the doctrine of "descent with modification."

The extraordinary development, in only a part of the genus, of a special sensory apparatus peculiarly useful to a fish unable, for any cause, to see, points the same way, and gives evidence of a *progressing* adaptation of these fishes to their unusual abode.

The intermediate relation of the sensory tubercles of Chologaster to the much smaller ones of young fishes and the permanent papillæ of Amblyopsis, points out the evident origin of the last through the permanency and higher evolution of structures commonly evanescent in the young.

is given to this surmise by the statement, in the papers cited, that his fishes were provided with only a single layer of delicate epithelium; whereas most fishes, and especially the naked and nearly naked kinds, are usually covered with an epidermis several layers deep, and by the further fact that the papillæ of Chologaster would accurately resemble those figured in Mr. Putnam's paper (except for the filament), if the former were denuded, as supposed.

After the above was sent to the printers, Mr. Putnam kindly sent me an alcoholic specimen of Amblyopsis with the epidermis intact over considerable areas of the head. An examination of the sensory structures of these regions at once showed the correctness of my surmise, that they are in Amblyopsis, as in the new Chologaster, to be definitely classed with the so-called "organs of the sixth sense," and are simply more highly developed examples of the structures found in the heads of young fishes. Each papilla bears at its tip a cluster of sensory cells in all respects similar to those above described; and I have little doubt that the figures of Prof. Wyman were made from denuded papillæ which had accidentally lost their sensory cells. The "filaments" seen by him on two or three of the papillæ were probably remnants of the cell clusters. The epidermis of the head is not composed of a single layer of delicate cells, as described by him, but of at least three layers—a deeper, columnar one, a median layer of large spherical or oval cells, with granular contents, and a superficial layer of thin, flat cells. The epidermis is, in fact, so thick that it almost or quite conceals the folds of the true skin upon which the papillæ are borne.

A fuller account of these structures will be given in another article.

A SINGULAR PARASITIC ISOPOD CRUSTACEAN AND SOME OF ITS DEVELOPMENTAL STAGES.[1]

BY CARL F. GISSLER, PH.D.

THE material for the present paper[2] was obtained from the common prawn of our shores,[3] *Palæmonetes vulgaris* Stimpson,[4] about ten per cent. of which I found infested, in June, 1881, with a Bopyrus *(Bopyrus palæmoneticola* Packard[5]), probably the same species which Professor Joseph Leidy mentioned as occurring near Atlantic city, N. J.[6] The female of our Bopyrus averages in size from 3.50 to 4.50^{mm} in length, and 3 to 4^{mm} in width. Its ventral side is invariably turned toward the carapace of the prawn and its marsupium or breeding cavity is usually filled

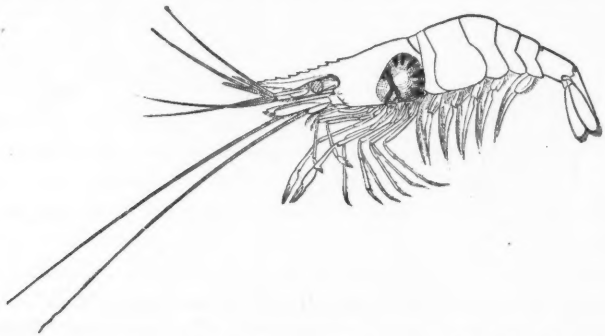

FIG. 1.—The common prawn (*Palæmonetes vulgaris* Stm.) with its parasite. Natural size.

with minute yellowish eggs of a nearly spherical form. From three hundred to three hundred and fifty eggs are contained in this cavity; the latter being formed by the prolonged lamellate margins of the thoracic segments.

The body of the female is of a whitish color, and as in all

[1] Jenaische Zeitschrift für Medicin und Naturwissenschaften, Vol. VI, 1, p. 53, 1870. Dr. Fritz Müller. (Bopyrus and Cryptoniscus.)

[2] Read before the 30th meeting of the A. A. A. S., August, 1881. In this paper the Bopyrus was provisionally called *B. manhattensis*.

[3] See also my note in *Scientific American*, Vol. XLI, No. 10, September 3d, 1881.

[4] Annals Lyceum Nat. Hist. N. York, Vol. X, p. 129, 1871.

[5] Zoology for High Schools and Colleges. By A. S. Packard, Jr., M.D., Ph.D. 1881, 3d ed.

[6] Proceedings Academy of Nat. Sciences, 1879. See also Report on the marine Isopoda of New England. By Professor Oscar Harger. p. 312.

members of this family, is somewhat distorted and unsymmetrical, one side having narrower segments than the other, and is therefore of a triangular shape.

Degeneration as a result of parasitism is manifested in the absence of eyes as well as antennæ proper, in the clumsy form of the feet and the much reduced mouth-parts. The head evidently consists of two unequal fleshy lobes. The dorsal cephalic lobe is triangular and somewhat unsymmetrically placed, the ventral lobe is of subquadrate shape, anterior angles produced, posterior angles rounded, with the middle of its posterior part prolonged and rounded.

Of the mouth parts I was unable to find more than one pair of maxillæ inserted at the sides of the ventral cephalic lobe. They constitute a flat, roundish, terminal piece, the palpus, with nine marginal hyaline tentacles;[1] the basal joint is connate with and obliquely inserted into the median lobe. A number of muscle-nerves (muscle and nerve together) run to the tip of the basal maxillary joint, some of which enter the palpus, others (three) distribute themselves along the outer tip of the former, entering three longer and stouter marginal tentacles. A beautiful dendritic arrangement of black pigment is found near the base of the palpus.

From underneath the body of the ventral cephalic lobe arise a number of narrow, ligulate, gill-like appendages, which are, in the live animal, kept in constant rapid paddling motion.[2] Viewed under higher microscopic power, they exhibit a granular structure with longitudinal, hyaline, evidently lacunary canals. If it was not for their abnormal position near the anterior part of the body and their structure, I should regard them as gills, but to be consistent, am obliged to see in them paddling organs for the purpose of aërating the eggs or embryos contained in the marsupium.

The seven pair of feet are curved forward and downward, and terminate in an indistinct hook-like knob. The black pigment is very irregularly distributed in the feet, some are all yellowish, others but slightly pigmented, and again others are nearly all black. This I have observed in live specimens, and it seemed to

[1] Compare with C. Spence Bate and J. O. Westwood's History of the British sessile-eyed Crustacea, Vol. II, p. 218, fig. 9.

[2] C. Spence Bate and J. O. Westwood, op. citat. p. 220. * * * furnished with two or three membraneous, flattened, pointed appendages.

me that, when black, the pigment is centrally located in the legs. The thoracic segments have, as apparently in all Bopyridæ, their margins prolonged into more or less lanceolate pigmented lamellæ. To these lamellæ the feet are attached. The lamellæ attached to the first pair of feet is a small, beautifully pigmented oval lobe, and its entire margin is fringed with delicate tentacles. The second and third pair of feet have very broad lamellæ, with forward directed sub-ovate tip, and with their anterior margins fringed. The fourth, fifth and sixth pair of foot-lamellæ are short, broad and irregularly triangular pieces; seventh lamella very long, narrow, lanceolate.

The marsupium is an open, roundish cavity, surrounded by the above-mentioned lamellæ, and covered by the carapace of the prawn.

The abdomen is deeply segmented, and ventrally provided with roundish appendages overlapping each other in the median line. I have closely observed the live females, and doubt that those abdominal appendages functionate as gills. They consist of a larger thick fleshy lobe, and a smaller, still thicker roundish piece. They are the degenerate postabdominal legs, characteristic of the order of Isopoda. Usually four, but sometimes six pairs of the thoracic epimera are more or less black pigmented.

The male averages about 1^{mm} in length by 0.25^{mm} in width. Head with a pair of lateral pigment eyes. Head and seven thoracic segments black pigmented, the pigment exhibiting, beside the ordinary form, a pretty stellar arrangement.

Anterior angles of thoracic segments oblique, abdominal segments four, pale, their margins perfectly round, segments gradually becoming narrower toward the terminal median piece, which is minute, and, on treating with acetic acid, is seen to consist of two lobes.

The last of the thoracic segments, not being as fully pigmented as all the preceding, exhibits dorsally a twisted, serpentiform (bretzel-shaped) marginal ornamentation.[1] Eight pairs of legs with powerful claws. Antennæ apparently two-jointed, first joint club-shaped, with five minute bacilli on its tip, second joint much narrower, about one-quarter as long as the first, with six bacilli at its tip.

[1] Similar to the male of *Cepon distortus* Leidy, Journ. Acad. Nat. Sc. Phila., Vol. III, 2d series, 1855 to 1858, Plate XI, Figs. 26 to 32.

PLATE I.

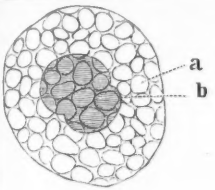

FIG. 1

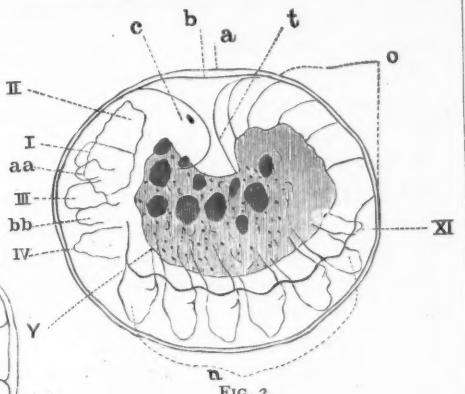

FIG. 2.

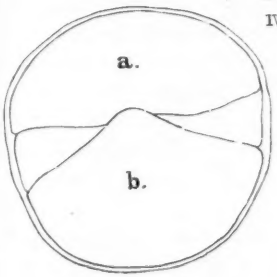

FIG. 3.

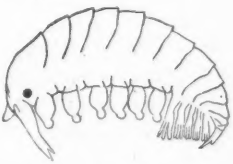

FIG. 4.

FIG. 4 *a*.

FIG. 4 *b*.

FIG. 4 *d*.

FIG. 4 *c*.

FIG. 5.

BOPYRUS PALÆMONETICOLA.

The live males were removed from under the lobes of the abdomens of the females (one male in each female, and always on the same spot) and placed on paper wetted with salt water, where they slowly walked about in a sideways direction. The females moved their legs to and fro, and contracted their abdomen only on touching the ventral appendages. They kept rapidly paddling with their gill-like cephalic appendages as mentioned above. I presume that the male and female get their necessary aëration through the motions of the gills of the prawn, and as the embryos are laterally covered by the marsupial lobes of the females, and exteriorly by the carapace of the prawn, the additional fanning of the female cephalic appendages is intended for aërating the eggs or the embryos only. The functions of the gills in the carapace of the prawn infected with the Bopyrus, are undoubtedly impaired through the presence of the latter, thus shortening the life of the former; the lessened aëration conditions but one brood of the Bopyrus; both adults of the latter gradually die off *in ratio* with the prawn.[2] The embryos after quitting their larval skin,

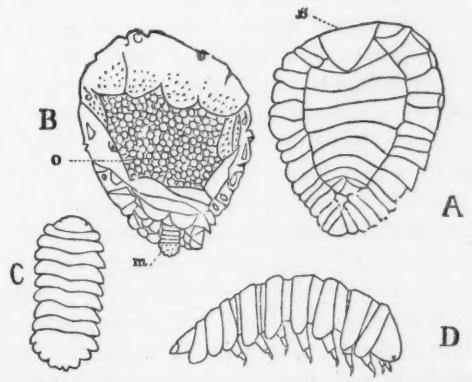

FIG. 2.—*Bopyrus palæmoneticola* Pack., much enlarged. (From *Scient. Amer.*, Sept. 3, 1881). *A*, female Bopyrus, dorsal view; *B*, ventral view of same, *C*, dorsal view of male; *D*, male, side view; (*B*) *e*, eggs; *m*, male.

[1] This is also the case with Cymothoa, according to Professor J. C. Schiödte in Annals Mag. Nat. History, Ser. v, Vol. 2, 1878, p. 195. On the Propagation and Metamorphosis of the suctorial Crustacea of the family Cymothoidæ.

[2] The suggestion that the Bopyrus and its host die "in ratio" together, was supported by several experiments, by placing separately about half a dozen of both infected and healthy prawns into quart jars full of marine water, wherein in every instance the infected prawns died several hours before the non-infected ones.

are, what Bate and Westwood have already hinted at, in their highest and most advanced stage; the organs of sense and motion being proportionately larger and better developed at that period of their existence than ever after. In this free stage the young get their aëration through the entire integument. I suppose that after the brood of larvæ have left the marsupium of the female, they will actively swim about in the sea, attaching themselves, if possible, to egg-clusters of female prawns;[1] with the young of the latter they simultaneously grow up, and enter their branchial cavity in pairs at an early period of life.

In June, 1881, I found a few (out of several hundred) live females with males, the former with empty marsupia, which fact led me to believe that this Bopyrus may produce more than one brood, but the few cases may either be exceptions or, what is more likely, the broods had just left their marsupia, leaving the parents to their fate.

The following observations were made on the eggs and embryos taken from the marsupium of live female specimens. The specimens were obtained during May, June and July this year (1881), and the number of more advanced developmental stages was not at all augmented in the latter month, nor was this the case with a lot received late in August. By far the greater number of prawns, regardless of sex,[2] exhibited through their transparent carapace the yellowish eggs of the female Bopyrus, nearly all, with but a few exceptions, showing under the microscope the peripheric blastoderm cells within which a larger or smaller, entire or subdivided yolk-mass could be distinguished (see Pl. 1, fig. 1). The few exceptions just mentioned showed, when viewed from the side, the budding limbs and segments very indistinctly, the two body-ends however, head and tail (pleon) being more distinct, exhibiting the form seen in Pl. 1, fig. 3. Those prawns which showed through their swollen carapace a more grayish mass, contained the Bopyrus embryos invariably in their larval skin, a drawing of which is seen in Pl. 1, fig. 2.

These embryos contained a central undifferentiated yolk-mass, with a few yellow oil-globules and some larger orange-colored

[1] Bate and Westwood, p. 217.

[2] Dr. Heinrich Rathke (I quote from Bate and Westwood, p. 217) found the female Bopyri upon female prawns, of which he had observed several hundreds thus infected, whilst quite as many male prawns were found to be free from their attacks.

pigment masses, the latter being nearer the dorsal line. It must be understood that the embryo in Isopod crustaceans is bent backward, head and tail nearly touching each other, the limbs, on the other hand, being in the peripheric layer. In Fig. 4 an embryo is shown freed from the egg-skin or chorion, thereby turned into its opposite direction, concave ventral and convex dorsal side. A pereiopod or thoracic leg; the end of the abdomen (telson) with the last pair of legs (uropods), a pleopod, one of the second pair of antennæ with *dd*— ? remnants of earlier embryonic bristles—are shown respectively in Figs. 4, 4 *a*, 4 *b*, 4 *c*, and 4 *d*. By working with the dissecting needles, the embryo (in Fig. 4 freed from the chorion, but still enclosed in its larval skin) with some difficulty could also be freed, limb after limb, from its larval skin (amnion), then appearing as in the much enlarged Fig. 5. This, as has already been said, is the highest and most advanced stage of the Bopyrus, which, under favorable circumstances, will enter the gill-cavity of the earlier developmental stages of the prawn, where it, as the prawn advances, will, when a female, lose its eyes, both antennæ, the uropods, etc.; while the pleopods will deform into the abdominal lobes and from the seventh free segment will bud a pair of legs. But if a male, where does the eighth pair of thoracic legs originate from? From the first pair of pleopods? I should rather infer that the pair of uropods will yield the eighth pair of legs in the male. The fact that the male has no abdominal appendages (so-called gills of the female) gives strength to the assumption that the eighth pair of legs in the male are derived from one pair of the pleopods, since the former (female) have the same origin.

EXPLANATION OF PLATE I.

FIG. 1.—Egg after segmentation.
a. Blastoderm-cells.
b. Subdivided central yolk ball.
FIG. 2.—Later stage. Lateral view.
c. Head.
a. Chorion.
b. Larval skin—amnion.
aa. Mandibles.
bb. Maxilla.
I. Antennula.
II. Labrum.
III. Antenna.
IV. Maxilla?
y. Yolk with orange pigment balls.
n. The six thoracic legs (Pereiopoda).

XI. Seventh free thoracic segment.
o. Twelfth to sixteenth segment (abdominal segments, pleopods concealed).
t. Telson, uropods covered beneath the dorsal bent.

FIG. 3.—Profile view of embryo; dorso-ventral.
a. Head.
b. Pleon.

FIG. 4.—Older embryo in larval skin. Lateral view.

FIG. 4 *a.*—Telson or fourteenth segment with the uropods of Fig. 4 in larval skin. Highly magnified. Showing pigment.

FIG. 4 *b.*—One of the pereiopods of larva (Fig. 4) in larval skin.

FIG. 4 *c.*—A pleopod of larva (Fig. 4) in larval skin.

FIG. 4 *d.*—Second antenna of the same stage.
dd. Remnants of earlier embryonic bristles ?

FIG. 5.—Latest larval stage.
c. Head.
l. Labrum.
m. Mandibles (?) with labium.
antl. Antennula.
ant. Antennæ.
oc. Eye.
per. The six pereiopods.
f. s. Seventh free segment.
plpd. The five pleopods.
t. Telson, bearing the
u. Uropods.
p. Orange pigment spots.

EXPLANATION OF PLATE II.

FIG. 6.—Stellar form of pigment of adult male; from dorsal side.

FIG. 7.—Leg of adult male Bopyrus.

FIG. 8.—Antenna of male B. magnified 500 ×.

FIG. 9.—One of the maxillæ with palpus of the female.
arthr. Original joint.
mn. Muscle-nerves.
p. Dentritic pigmentation.
t. Maxillary palpus with nine tentacles.
l. Disconnected part (from the other half).
β. Anterior free lobe.

FIG. 10.—First thoracic lobe of female.
p. Pigment.
t. Tentacles.

FIG. 11.—Outline of one of the abdominal appendages (gills) of female.
l. Smaller, thicker lobe, put aside.

FIG. 12.—Schematic figure showing position of the two maxillæ underneath the cephalon.

PLATE II.

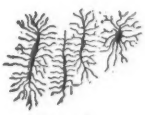

FIG. 6.

FIG. 7.

FIG. 8.

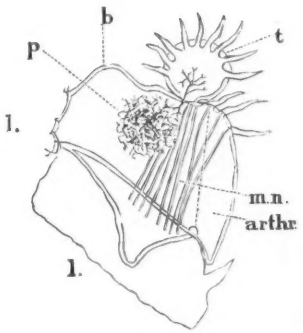

FIG. 9.

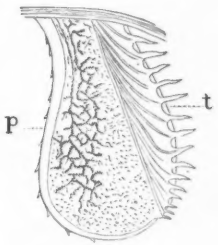

FIG. 10.

FIG. 11.

FIG. 12.

BOPYRUS PALÆMONETICOLA.

THE HETEROGONY OF OXALIS VIOLACEA.

BY WILLIAM TRELEASE.

IN May of the present year, after collecting specimens of the violet wood-sorrel about Madison, Wis., I noticed that I had succeeded in getting two well-marked forms of flowers, in one of which the pistils were considerably longer than the stamens, which were in two sets of slightly different length, while in the other the pistils were shorter than either set of stamens. On the supposition that these were respectively the long-styled and short-styled forms of a trimorphic species, careful search was made for the mid-styled form. In a class exercise in analysis, something over one hundred plants were studied, but only the two forms above mentioned were found, and in nearly equal num-

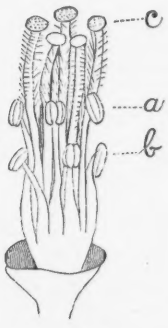

FIG. 1.

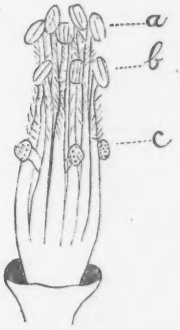

FIG. 2.

FIG. 1.—Long-styled flower of *Oxalis violacea*. FIG. 2.—Short-styled flower of the same species. Magnified eight diameters.

bers. An examination, made by myself, of the flowers of about a hundred additional plants, from different localities within an area of a few miles, gave a similar result.

Up to this time no accurate record of the number of plants of either form, or of the absolute lengths of stamens and pistils had been made, attention having been given only to the presence or absence of mid-styled flowers, and, in a general way, to the relative abundance of the two forms which were found. After this eighty-one flowers, gathered at random from as many plants, were carefully examined, and it was found that in fifty-one the styles were nearly twice as long as the average of both sets of stamens, while the styles of the remaining thirty were shorter than either

set of stamens, the latter being about equal to the pistils of the long-styled flowers. These forms are represented in Figs. 1 and 2. The measurements of the flowers referred to, are given in the following tables:

TABLE I.—OXALIS VIOLACEA.

Measurements of Stamens and Pistils from Long styled Flowers.

Flower Numbers.	Pistils.	Long Stamens.	Short Stamens.
1	5. mm.	3.2 mm.	2.5 mm.
2	4.5 "	2.8 "	2. "
3	4.6 "	3. "	2.2 "
4	4.8 "	2.8 "	2. "
5	4.4 "	3. "	2. "
6	4. "	2.8 "	2. "
7	5.6 "	3.5 "	2.6 "
8	4.8 "	2.6 "	1.8 "
9	4.8 "	3. "	2.5 "
10	4.5 "	3. "	2. "
11	5. "	3. "	2. "
12	4. "	2.4 "	1.8 "
13	4.6 "	3. "	2. "
14	4.6 "	2.5 "	2. "
15	4.8 "	3. "	2. "
16	4.2 "	3. "	2. "
17	4.6 "	2.8 "	2. "
18	4. "	2.2 "	1.6 "
19	5. "	3. "	2. "
20	4. "	2.8 "	2. "
21	4.4 "	2.3 "	1.6 "
22	4.4 "	2.5 "	2. "
23	4.2 "	2.4 "	1.8 "
24	4.2 "	2.5 "	2. "
25	4.8 "	2.8 "	2. "
26	5. "	3. "	2. "
27	4.6 "	2.8 "	2. "
28	5. "	3. "	2.5 "
29	4. "	3. "	2. "
30	4.8 "	3. "	2. "
31	4.6 "	3. "	2. "
32	5. "	3. "	2. "
33	5. "	3. "	2. "
34	4.8 "	2.8 "	2. "
35	4.8 "	3. "	2. "
36	4.4 "	2.8 "	2. "
37	5.1 "	3. "	2. "
38	4.4 "	2.5 "	2. "
39	5. "	3. "	2. "
40	5. "	3.2 "	2.4 "
41	4. "	2.5 "	2. "
42	4. "	2.8 "	2. "
43	4. "	2.8 "	2. "
44	4.8 "	2.8 "	2. "
45	4.5 "	3. "	2. "
46	4.2 "	2.8 "	2. "
47	4.5 "	3. "	2. "
48	4.6 "	2.6 "	2. "
49	4.8 "	3. "	2. "
50	5. "	3. "	2. "
51	4. "	2.5 "	2. "

TABLE II.—OXALIS VIOLACEA.

Measurements of Stamens and Pistils from Short styled Flowers.

Flower Numbers.	Pistils.	Long Stamens.	Short Stamens.
1	3. mm.	5.1 mm.	4. mm.
2	3. "	5.1 "	4. "
3	2.4 "	5. "	4. "
4	2.3 "	5. "	4. "
5	2.5 "	4.2 "	3. "
6	2.5 "	5. "	4. "
7	2.5 "	5. "	4. "
8	2.5 "	4.8 "	3.6 "
9	2.4 "	5. "	4. "
10	2.5 "	5.4 "	4. "
11	2.4 "	5.4 "	4. "
12	2.4 "	5. "	4. "
13	2.8 "	5.1 "	4. "
14	2. "	4.5 "	3.2 "
15	3. "	5. "	4. "
16	2.5 "	4.8 "	3.8 "
17	2. "	5. "	3.8 "
18	2.5 "	5. "	4. "
19	2.5 "	4.8 "	3.5 "
20	2.5 "	5. "	4. "
21	3. "	5.5 "	4.5 "
22	2. "	4.6 "	3.2 "
23	2.4 "	4.6 "	3.8 "
24	2.6 "	5. "	4. "
25	2. "	5.5 "	4.2 "
26	2.4 "	5. "	4. "
27	2.5 "	5. "	4. "
28	2.5 "	5. "	4. "
29	2. "	4. "	3. "
30	2.4 "	5. "	4. "

Though both stamens and pistils vary in length, as might, indeed, be expected from the fact that the flowers are by no means of uniform size, a glance at the tables and appended diagram shows that, as a rule, the styles of either form are intermediate in length between the two sets of stamens belonging to the other form; while the difference between the stigmas and the nearest set of anthers is, in either, greater than that between the stamens themselves, both differences being nearly constant for both long and short-styled flowers.

This is slightly different from the usual arrangement of the parts in trimorphic species, as may be seen by comparing Figs. 1 and 2, representing the species under consideration, with Figs. 3, 4 and 5, after Hildebrand, representing the trimorphic *O. gracilis*. That the long stamens of the long-styled flowers, and the short stamens of the short-styled flowers stand at different heights—as may be most clearly seen by comparing the lines *a* and *b'* in the diagram—and not at the same height, is, it seems to me, of

some importance. In trimorphic plants too, the pollen grains from the two sets of stamens of a given flower commonly differ

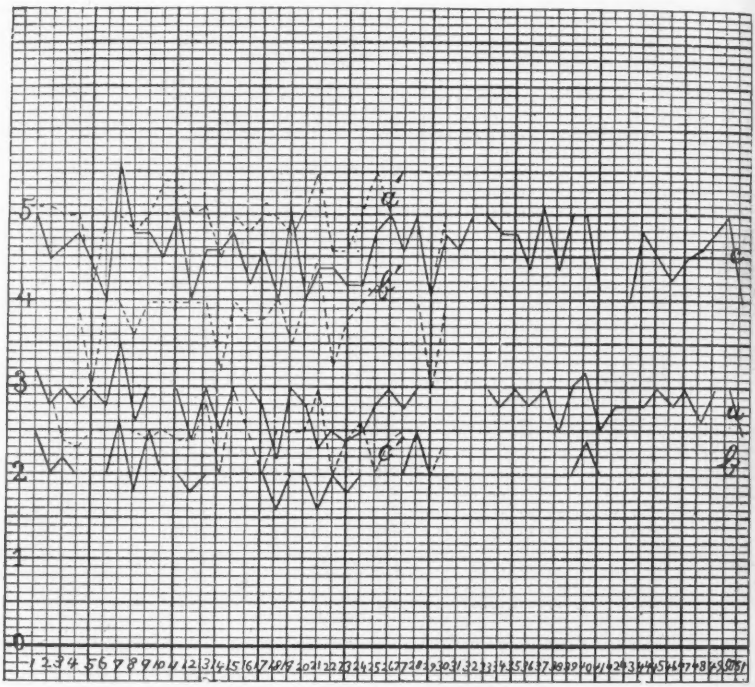

Diagram showing the relative lengths of stamens and pistils in eighty-one flowers of *Oxalis violacea;* from Tables I and II. The unbroken lines connect coördinates representing measurements of long-styled flowers; the dotted lines connect those for short-styled flowers. *a*, the long stamens; *b*, the short stamens; *c*, the styles. The heavy line marked *o* represents the base of the corolla; the other transverse lines representing millemeters and fractions.

noticeably in size, but the following measurements of pollen from three flowers of each sort do not show this difference:

TABLE III.—OXALIS VIOLACEA.

Measurements of Pollen from Long-styled Flowers.

Flower Numbers.	Long Stamens.	Short Stamens.
1.....	44 μ. × 24 μ.	44 μ. × 24 μ.
2.....	44 " × 24 "	44 " × 24 "
3.....	44 " × 24 "	44 " × 24 "

TABLE IV.—OXALIS VIOLACEA.

Measurements of Pollen from Short-styled Flowers.

Flower Numbers.	Long Stamens.	Short Stamens.
1.....	50 μ. × 28 μ.	48 μ. × 27 μ.
2.....	50 " × 28 "	52 " × 34 "
3.....	52 " × 32 "	48 " × 28 "

These grains were measured dry, immediately after removal from newly gathered flowers. It will be seen that those from both sets of stamens in any flower, are nearly equal in diameter; while, as is usual in heterogonous plants, those from the short-styled flowers are larger than those from the long-styled.

FIG. 3.

FIG. 4.

FIG. 5.

FIG. 3.—Long-styled flower of *O. gracilis*. FIG. 4.—Mid-styled flower of the same. FIG. 5.—Short-styled flower of the same. The calyx and corolla have been removed in every case.

The facts indicated appear, so far as they go, to point to dimorphism rather than trimorphism in this species; although with truly trimorphic plants, one or even two of the forms may occasionally be absent from a given district. Concerning the local occurrence of but two forms of trimorphic plants, Mr. Darwin[1] says: "Fritz Müller formerly believed that a species of Oxalis, which is so abundant in St. Catharina that it borders the roads for miles, was dimorphic instead of trimorphic. Although the pistils and stamens vary greatly in length, as was evident in some specimens sent to me, yet the plants can be divided into two sets, according to the lengths of these organs. A large pro-

[1] Different Forms of Flowers on Plants of the same Species, p. 180.

portion of the anthers are of a white color and quite destitute of pollen; others which are pale yellow contain many bad with some good grains; and others again which are bright yellow have apparently sound pollen; but he has never succeeded in finding any fruit on this species. The stamens in some of the flowers are partially converted into petals. Fritz Müller after reading my description * * * of the illegitimate offspring of various heterostyled species, suspects that these plants of Oxalis may be the variable and sterile offspring of a single form of some trimorphic species, perhaps accidentally introduced into the district, which has since been propagated asexually." A case somewhat similar to that of *Oxalis violacea* about Madison, is afforded by a Brazilian species of Pontederia, of which Fritz Müller[1] found only long and short-styled flowers. An important difference, however, is found in the measurements of the pollen from the different sets of stamens of a given flower; for "the pollen grains distended with water from the longer stamens of the short-styled form are to those from the shorter stamens of the same form as 100 to 87 in diameter, as deduced from ten measurements of each kind. * * * Moreover, the longer stamens of the long-styled form of Pontederia, and the shorter ones of the short-styled form are placed in a proper position for fertilizing the stigma of a mid-styled form."

"With respect to the absence of the mid-styled form in the case of the Pontederia which grows wild in Southern Brazil," Mr. Darwin adds, "this would probably follow if only two forms had been originally introduced there; for, as we shall hereafter see from the observations of Hildebrand, Fritz Müller and myself, when one form of Oxalis is fertilized exclusively by either of the other two forms, the offspring generally belong to the two parent-forms."[2]

Whether in *O. violacea* we are dealing with a case of this sort, or whether the species is dimorphic, can only be definitely decided by the examination of many specimens collected over as large a range of territory as possible, and it is to be hoped that those who have the opportunity will make observations of this sort. Meantime it seems not improbable that the plant is dimorphic; and although dimorphic species are as yet unknown in this genus,

[1] Jenaische Zeitschr., VI, 1871, p. 74, fide Darwin. l. c., p. 184.

[2] l. c., p. 185. cf., also p. 212.

so far as I am aware, the occurrence of both homogone and trimorphic species gives some reason for looking for still others which are dimorphic. In writing this I am perfectly aware that Hildebrand[1] has examined a few herbarium specimens of *O. violacea*, finding eight long-styled, three short-styled, and one mid-styled plant in the twelve specimens examined. The constant lack of correspondence in our specimens between the sets of stamens which should correspond, however, leads one to wonder if a mistake may not have been made, especially since a slight discrepancy exists between the numbers cited and the summary, in the paragraph cited.

Both the long and short-styled flowers are visited by small bees in considerable numbers, the more common being *Nomada bisignata*, *Ceratina dupla*, *Augochlora pura*, an Osmia, and several species of Halictus. These insects are attracted by the nectar which is secreted, apparently, by the papillose bases of the petals, and which is protected from rain, &c., by pubescence on the styles in the long-styled flowers, and on the filaments in the other form. As a result of these visits, some flowers of both kinds produce capsules, which are by no means uncommon, although by far the greater number fall away without bearing any fruit.

——:o:——

FORESTS—THEIR INFLUENCE UPON CLIMATE AND RAINFALL.

BY J. M. ANDERS, M.D., PH.D.

THAT there exists some sort of relation betwixt forests and conditions of climate, perhaps most observers would be ready to concede. Many attempts have been made to explain how forests affect atmospheric states, but there is great diversity of opinion on the subject, and, indeed, the question to-day remains somewhat involved in obscurity. As every one knows, there was a time when forests were considered almost inexhaustible. It is also a well-known fact that the destructive hand of man began, centuries ago, to fell rapidly these abundant forests, and changes of climate and fertility of the soil have, in numerous regions, been attributed solely to this denudation of the land. On examining the literature of the subject, it is found that the balance of

[1] Monatsber. Berlin Akad., June 21, 1866, p. 357.

argument and opinion is decidedly on the side of the baneful effects of the destruction of forest growth, the testimony of some of the best scientific minds of different ages being very strong on this point.

It is but fair to say, however, that not a few observers of note deny any effects of woods on the moisture and other conditions of the atmosphere; and even stranger still, it has been declared that the climate of the Western States has, if anything, been improved by the denudation of forests; but this assertion rests, we think, on too slender evidence to be entitled to credence. It may be safely assumed that forests favorably affect the meteorological conditions. Our subject presents many difficulties owing chiefly to the fact that numerous causative elements enter into the question, some of which are of a conflicting tendency, and though a question so confessedly intricate may perhaps never be susceptible of solution, nevertheless any new light on the subject, however faint the ray, must be considered welcome.

One of the ways in which forests are usually considered to exert an influence over the climate, is by obstructing the free passage of wind currents. This is an element of the question which is, perhaps, better established than any other, but is of too great importance to be disposed of in a summary manner. It is evident that trees are well adapted to break the force of the wind; the branches, and particularly the leaves, on account of their immense numbers and close proximity, serve as efficient barriers, and the trunk holds up the bushy top and defies the tempest, while roots in turn are continually extending their grip on mother earth in order to support the trunk. And it can be readily understood that the particles not checked by the first row of trees to the windward, would have their force diminished and be promptly checked by the trees to the rear. In this wise belts or clumps of trees afford shelter to the leeward of them from the chilly, or even frigid blasts, which are known in many localities to be very unfavorable to the maturation of fruit-crops and harvests. Of little less importance, perhaps, is their effect in protecting from the drying winds of summer, which are frequently the cause of blighted crops and other mischief, due to their power to enhance evaporation from vegetation and from the soil during the dry season. For this reason woods are also needed even on our coast. The sea breezes as they strike the land become warmed, their

capacity for moisture is thereby increased, and naturally absorb with avidity the earth's moisture and produce a drying effect. It is plain to be seen then, that woods by intercepting cold currents and drying winds, mitigate extremes—rendering summer less sultry and winter less severe, though they may not materially affect the mean temperature. In like manner they must tend to obviate the injurious consequences of cold spring and autumn winds, and thereby relatively lengthen the warm season or term of vegetable development. This is a highly important office, since some crops are slow in maturing.

The experiment has been tried extensively in France of planting trees in belts one hundred meters apart, and with marked benefit to the climate, and there are some good reasons for believing that a similar experiment in various places in our own country, would prove equally advantageous. It has been observed many times that fruit grown in the city surpasses in quality and size that grown in the country, and this is ascribable to the more effectual shelter in the former place.

The wind as it courses over an open country conveys with it a variable quantity of moisture, which, though usually invisible, is always present in the atmosphere, which is likewise arrested by the forest. Now what becomes of this moisture? The air is forced up by the side of the woods to the tops of the trees just as in the case of a low mountainous elevation, and owing to the attraction between its particles and the constant *vis a tergo* caused by fresh currents from behind, the volume does not stop here but rises higher. When the temperature of the air above is lower than that in the forest, as is sometimes the case when storms prevail, then there would also be an upward current from the tree tops. It is usually considered that in this manner forests increase the aggregate general rainfall, viz., by causing ascending currents to sufficiently high regions for the moisture to be condensed into clouds and rain, and this has been held by some to be the only way in which they influence precipitation. Meteorological science has, however, established the fact that rain is generally formed from one to two miles above the surface of the earth, and it would scarce be possible that an obstruction no higher than an ordinary forest could, *per se*, be capable of raising the vapor-laden air to this extent and could not actually increase the rainfall. On the other hand, when forests are situated on ele-

vated ridges or mountains of moderate elevation, they may have the effect of extending the influence of the latter a step further in producing an upward current to the cooler regions, or condensing area, and in this manner greatly assist local precipitation. It is now a settled fact that high mountains augment the rainfall in themselves or even to some little distance from their bases. The Alps of Switzerland are known to modify and greatly influence the course of storms. We repeat it then, that forests resemble high altitudes as regards their *mechanical action* in affecting the rainfall, but owing to their meagre height, can scarce be said to have any influence (mechanically) over this phenomenon except they are situated upon the latter, in which case their action may tell considerably. Forests do, however, affect local precipitation through certain vital functions, as will be seen by and by.

No other influence which forests exert upon atmospheric conditions can claim so large a share of importance as that exercised on its humidity. The explanation of their effect on this meteorological element is to be found mainly in a study of some of the organic processes carried on by trees, but to a slight extent also to a mechanical action. The evaporation from the soil is interfered with by the vegetable canopy above, which prevents, in a great measure, the sun's rays from reaching the earth and heating it so as to facilitate evaporation. Again, by forming a more or less perfect screen interposed between sky and earth, forests in a measure intercept the dew and lighter rains, allowing but a portion of this moisture to reach the earth. *It has been estimated that the evaporation from the soil of the forest is rather more than one-third as great as that from open soil, but this lessened surface evaporation is much more than compensated for by transpiration of the forest, as will be indicated by the results of our investigations.*

The question of the influence of the organic functions of plants on the humidity of the air, is one of paramount importance and great philosophic interest. Whatever effect plants have through these processes must be due either to the exhalations of moisture from the leaves (transpiration) or to the absorption of moisture by the leaves. The latter idea, as formerly taught and until recently held by most authorities, is now most probably shown to be erroneous. According to the researches of Unger[1] the theory of the absorption of the watery vapor by the leaves is untenable.[2] My

[1] Wilhelm der Baden und der wald, p. 19, quoted by Marsh.

[2] The writer regrets that the details of these experiments are not accessible.

own observations tend to confirm the conclusions of Unger. A growing pot plant (geranium) in a thrifty condition was experimented with. The whole of the pot was covered with a double layer of oiled silk, and the free portion accurately adjusted around the base of the stem, on which it was tied with elastic cord. Thus prepared, no evaporation could take place from the soil in the pot, and what is of more importance still, no moisture could be thus supplied to the roots excepting that which was contained in the soil in the pot. The plant was now placed under a glass case which was situated over a shallow box in which there was about four inches of soil which was kept saturated so that the evaporation from it kept the air of the glass chamber quite moist. The whole arrangement was placed near a window with a southern exposure, the plant catching the rays of the sun for about five hours of the day in clear weather. In this situation the plant remained quiescent or dormant so far as any visible growth or development was concerned, for about two weeks, when it began to look languid and the margins of the leaves began to change in color and to show slight signs of failing nutrition. The explanation of this apparently long state of hybernation in the plant is simple. The air in the case being too moist to allow of scarce any transpiration, the plant retained the moisture in the pot for purposes of nutrition only, and since the plant most probably grew but little during that period, there was quite sufficient water in the pot for its uses for so long a time. At the end of the two weeks the plant was taken out of the glass case and placed in a sick chamber with the same exposure, in which three dozen other thrifty plants were situated. The oil silk was allowed to remain on and no water was supplied to the roots of the plant. The atmosphere of the chamber was noticeably moist to the senses, though agreeable. Here the sun's rays had an opportunity of exciting the plant to transpire actively, and, as a consequence, in a few days nutritive change became very decided, leaf after leaf drying until at the end of another fortnight only a couple much withered leaves were left on the plant.

Now this experiment is not sufficiently conclusive to assure us that absorption of moisture by the leaves is *impossible;* but it certainly must show to the satisfaction of every one that not sufficient water can be taken in through them to carry on the normal functions of the plant, and renders it extremely probable the only source of moisture to the plants is through the roots.

On the other hand actual observation has shown that transpiration is carried on with almost incredible activity—the rate at which aqueous vapor is given off by plants being more than one and a quarter ounces per square foot of leaf surface for twelve diurnal hours.[1] Let the reader reflect upon the vast expanse of leaf surface of a single tree giving off vapor at this rate, and then let him consider the number of trees in a forest of only a few acres, the number being variously estimated at from 150 to 600, and multiplying these two factors he will be able to form some approximate idea of the enormous amount of aqueous vapor supplied to our atmosphere in the most acceptable form.

During the past summer I have instituted a series of experiments with the view of determining the amount of water vaporized from known areas of leaf surface, land surface and water under similar circumstances, in order that a more nearly correct estimate of evaporation from these various sources might be made.

A pot plant having one square foot of leaf surface was carefully prepared — in the manner previously described—so as to prevent any evaporation from the pot in which it was growing. Another glazed pot was filled with soil (a light clay loam) so as to expose a surface area of only twenty-four square inches, the pot being about the same size as that containing the plant, and the depths of the pot very nearly six inches. The plant was sufficiently watered to keep it in a thrifty condition, while the earth in the plantless pot was kept generally well saturated. Both were equally exposed to the outer air. The evaporation from earth and plant was now tested simultaneously by weighing the two pots at stated intervals, and it was found that the mean evaporation was, in fair weather, nearly equal for the two sources, with a slight preponderance on the side of the soil. For fourteen consecutive days of clear and partly cloudy weather, the mean transpiration from the plant was a little over one and a quarter ounces, and the evaporation from the soil one and a third ounces. This would place the rates of evaporation of equal areas of leaf and land surface, under like circumstances of exposure, at about six to one in favor of the soil, that is to say, one square foot of soil will evaporate six times as much as one square foot of leaf sur-

[1] "Transpiration of Plants," AMERICAN NATURALIST for March, 1878, by the author.

face. This will appear quite plain when it is remembered that the extent of the leaf surface was six times as great as that of the soil, and that the total diurnal evaporation was so nearly equal from the two sources. These experiments were several times repeated, and with about similar results.

Now if it were known how many times greater the leaf surface of a great forest than the land on which it was situated, it might with ease be computed what is the relative evaporation from a forest and an equal area of open country. From personal observation and computation, we think it safe to assume that the leaf surface of a wood is at least twelve times greater than the ground on which it stands, so that at the above rate the transpiration from the forest would still be nearly twice as great as the evaporation from an equal area of free soil. It should be mentioned also that the evaporation from the earth in this case was under the most favorable circumstances, and the state of the ground as regards moisture was very like that of the open earth directly after a moderate rain. It was found by testing to be nearly equal to that given off by a similar area of water.[1] It would appear certain, then, from these investigations, that more water is emitted to the atmosphere from a forest than from an equal body of water, and in this there is a confirmation of the experiments of Williams who computed that the evaporation from a wood was one-third more than an equal space covered with water.[2] It is well known that at times, during the warm season more particularly, we have no rain for several weeks, so that the mean general surface evaporation is probably not by any means as great as would be indicated by these figures—for it was found that by allowing the soil in the pot to become even moderately dry, the amount evaporated would fall far short of what it was when keeping the soil well watered. On the other hand we have good reasons for believing that the true rate at which forests give out aqueous vapor is, at all events, not over estimated in these researches. In the first place the trees are at all times supplied with a more abundant supply of moisture for transpiration — owing partly to power which the roots have to attract moisture from every direction; partly to the retention of the rainfall in their network to be in due

[1] The same methods were used as in the experiments with the soil and plant.

[2] Agricultural Report for 1865, p. 526. Unfortunately the methods employed by this investigator are not given.

season absorbed by the myriad root hairs, and partly also to the circumstance that the vegetable mold usually carpeting the soil of the forest is well qualified to soak up water and prevent its running off too rapidly through superficial channels.

The humbler specimens of vegetation also have an effect, as is conclusively shown by the following experiment: A pot with artificially prepared soil, similar to that used in the above experiments, was used. Another vessel of the same size and weight in which grass *(Poa annua)* about four inches high was growing, was also employed. Now it was found by repeated testing that from the pot containing the grass the evaporation exceeded that of the pot having only soil. The rates in ounces would be about five to four for the grass and soil respectively.

From all these investigations the writer is able to confirm his former investigations in regard to transpiration,[1] and in these experiments it was particularly observed that while the evaporation from the soil was greatly influenced by temperature and the degree of humidity—for the mean temperature and dew point were both noted in all these experiments—transpiration was excited to a greater degree by the direct rays of the sun.

From the data just obtained it would seem safe to infer that when the percentage of woodland is fair (25 to 30 per cent.) at least twelve inches of water is transpired in the course of a season in mild or temperate climates, or, in other words, twelve inches of the total annual terrestrial evaporation. All this vast amount of water is transpired in about six months, or during the vegetative period. Under these circumstances an equivalent of nearly half the rainfall during the warm season may be accounted for by the transpiration. These are striking facts, and tell in indisputable terms of the happy effect of plant life upon the humidity of our atmosphere, as this substance in due proportion is very essential to an equable and salubrious climate. Were it not that the atmosphere was properly moistened so as to intercept nocturnal radiation from the earth, our cereals and other products of husbandry as well as vegetation generally, would greatly suffer if not be entirely destroyed by the resulting frost.

It is also a noteworthy fact that the exhalation of moisture from the vast surface presented by the leaves is nearly constant even during long droughts; and when streams and shallow waters

[1] Transpiration of Plants, AMERICAN NATURALIST for March, 1878.

have dried up, evaporation from the soil outside the woods has almost ceased, transpiration continues unremittingly to furnish atmospheric moisture in order to keep as nearly as possible a uniform proportion of this important substance in the air. What an harmonious adaptation of means to an end does nature exhibit here—plant life atomizing tons and tons of watery vapor into the surrounding medium, even during time of drought, and this same vapor in turn protecting luxuriant vegetation from the evil consequences of terrestrial radiation. Moist air during winter tends to moderate extreme cold, during the summer, on the contrary, it tends to cool the draughts, hence forests by moistening the air in summer give us cool and delightful breezes; another means by which forests affect extremes of temperature.

This brings us face to face with the old question, do forests, apart from their mechanical action, to any extent affect the rainfall? Be it remembered that the total annual evaporation and rainfall bear a constant relation. We do not claim for forests that they influence in any degree the general course of storms, for the latter are governed by other and more general forces. May not forests, however, influence the local distribution of rains and dews, and within certain limits and periods of time, the amount of precipitation? We have seen that during the spring and summer the amount of water yielded to the atmosphere is very nearly equivalent to half the rainfall, even at Philadelphia. Now, granting that our premises are correct, it will be conceded that a part, at least, of the water atomized to the atmosphere by a wood, is most likely returned to the surrounding country in the form of rain or heavy mists. Where is this moisture given to the air by trees condensed into rain, and how produced? It has already been stated that rain is usually formed from one to two miles above the surface of the earth, hence it follows that forests located on mountain ridges, besides strongly favoring the ascent of vapor-laden currents by a mechanical effect as already pointed out, may also have their own moisture readily condensed, owing to their altitude as well as in the manner to be presently described. It will also be remembered that in considering the mechanical action of forests, it has been stated that when not situated upon mountain ridges they are incapable of raising the vapor-laden currents sufficiently high to be condensed into rain, and this is true, but there is a notable exception to the rule that rain is produced at so great an elevation as above indicated.

The demonstrable variation in temperature of the moist air of the woods and the currents outside, and the mingling of these, doubtless reduce the temperature sufficiently to cause local precipitation. At first sight it might appear impossible that this could result in anything so tangible as rain, but we must examine this question carefully. During the warm season the temperature of the air in the forest is lower than that of the air outside, which is due in a measure to the trees intercepting the rays of the sun, causing shade, which has a cooling effect, and partly also as pointed out by Pettenkofer (*Pop. Sci. Monthly* for Feb., 1878), to the slight draught which is always caused by shade in the open air. Every one who has ever passed from the open air on a hot mid-summer day to within the borders of a forest, must have experienced with a relish the refreshing influence of the shade. Again, the temperature of the trees of a forest, and even their tops, is found to be lower than the air in the forest. This fact is easily explained: the rapid evaporation of watery vapor from the leaves, as shown by our researches, renders the action of the solar rays neutral, and their temperature is somewhat reduced. The observation has been made (according to Pettenkofer) that the trunks of trees breast high, even at the hottest time of day, are 5° Centigrade cooler than the air of the forest. Ebermayer speaks of the temperature of the trees in a forest as being always lower than the air of the forest.

As already indicated by the present researches, forests moisten the air over, in and to some extent around themselves. Now in the light of these facts may we not be pardoned for concluding that warm currents sweeping over a country and striking the cool, moist air in and above the forest, and mingling with it would have a portion, at least, of the contained moisture condensed into gentle showers, extending their beneficent influence to neighboring fields? Again, let some stray current come along of a lower temperature than the air of the forest, and the moist air over the forest would readily be condensed, since it is a well-known fact that a moist air discharges its vapor more readily in the form of rain than a dryer atmosphere. We have now seen how trees can cause local rains; it will also be observed that the rain is formed chiefly above the forest, though it may be through the influence of winds that it falls to the earth for some distance around. *By increasing the frequency of light rains, forests tend to obviate*

drought, which is of ultimate importance to the farmers' crops and vegetation in general. It will be seen that all our deductions have been drawn largely from the known facts from observations.

The experiments of L. Fantiat and A. Sartiaux (Translation of a communication to the French Academy of Sciences, *Pop. Sci. Monthly* for June, 1875), which have come to the notice of the writer since the above has been written, are of great value as well as interest. Space is wanting to give at any length the experiments of these authors. They say: "We now made the following observations in the heart of the forest of Helatte, which embraces 5000 hectares of land. At the height of about six meters (say twenty feet) above a group of oaks and hornbeans eight or nine meters high, we placed a pluviometer, pscychrometer, maximum and minimum thermometers, and an evaporometer, so as to ascertain at that point the amount of rainfall, the degree of saturation of the air, and the rate of temperature and evaporation. In open air at a distance of only 300 meters from the forest, and at the same height above the ground as in the former case, we placed similar instruments under the same conditions. With regard to the rainfall and degree of saturation, the observations for six months showed the total rainfall to be 192.50^{mm} in the forest and 177.^{mm} in the open air, difference in favor of the forest, 15.50^{mm}. The degree of humidity for the open air showed a mean of 61.7, and in the forest 63°, difference in favor of the forest, 1.3°." These investigations are, in a measure confirmatory of my own.

Forests produce abundant dews. The formation of dew is dependent on two conditions, the radiation from objects near the earth and a certain proportion of moisture in the air. Just as in the case of the production of rain, the moister the air the more readily is dew formed, it requiring a less reduction of temperature, hence when the moistened atmosphere in the vicinity of a forest comes in contact with the night air, dew in abundance is the result. Having shown that the temperature of the trees, their leaves and the atmosphere in the woods is several degrees lower than the air without, it may be inferred that dew is frequently formed during the day in the shade, and, perhaps, over the forest, particularly when the atmosphere is tranquil or when there are but slight breezes, shedding its silent enlivening influence to fields and valleys round about. This is another office on

the part of forests not by any means to be despised, since heavy dews are often very refreshing in their effect upon vegetation, and doubtless add to the fertility of the soil in many instances. It is an observation worthy of note, too, that in some parts of the globe nearly all the moisture that reaches the earth is in the form of dew, *e. g.*, Egypt and Arabia.

It should be recollected that the action of forests, in every aspect considered, is more or less local in character. It follows, therefore, that the local distribution of woods is of the utmost importance. Our investigations likewise show the necessity for forest culture in regions where a proper proportion (from twenty-five to thirty per cent.) does not exist for their real benefit to the climate, while on the other hand they exhibit with equal force the folly of the ravages of the woodman's axe in destroying our primitive forests.

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GLACIAL MARKS IN LABRADOR.

BY A. S. PACKARD, JR.

THE engraving[1] illustrating this article, brings out clearly some of the characteristic features of the scenery of the coast of Labrador. In the foreground the rocky shore of the Horsechops, as the deep fiord is called, which is situated far up on the eastern coast of Labrador, has been ground down, smoothed and polished by the great mass of land ice which formerly filled Hamilton bay and moved slowly down from the table-land in the interior, and whose ice front must have presented to the sea a wall, perhaps 500 to 1000 feet high, at the end of which was probably a submarine bank or terminal moraine like those known to exist at the present day on the coast of Greenland and Spitzbergen.

Across the fiord on the shores of the bay, which rise abruptly in great rocky terraces—also a characteristic feature of Labrador and Arctic landscapes—may be seen scattered snow banks, which linger on these shores as late as August, while those in the more shaded, protected places may live on until the early snows in September give them a renewal of life, so that their existence may become perennial.

[1] From a photograph kindly presented to the author by William Bradford, Esq. The writer here acknowledges, with pleasure, the many facilities and kindnesses received during a voyage with this enthusiastic artist to the Labrador coast in 1864.

In this inhospitable, rigid climate, where the Arctic current passing out of Baffin's bay presses against the coast, bearing on its surface an almost continuous expanse of floe ice, forming a belt perhaps 500 to 1000 miles long by from fifty to sometimes one hundred miles wide, the temperature of the Labrador coast north of Belle isle is kept down to the average annual of 32° Fahrenheit, so that the climate of the more exposed parts of the coast of Labrador, particularly the capes and islands, is nearly identical with that of Southern Greenland. Indeed, many of the insects, the birds and mammals, as well as the flowers, are the same as those of Greenland.

At the head of the bays and fiords, where the soil is protected from the chilling influences of the damp easterly winds which blow inland over the belt of floe ice fringing the coast, the spruces attain a growth some twenty and thirty feet in height, and the flora and fauna is, in general, more like that of the region lying near the limit of trees in the interior of British America.

On the left side of the foreground is a hut of some squalid fisherman's family, built of hewn spruce logs, banked up on the sides and with the roof partially covered with sods from the wet peaty soil. Judging from the houses of the Labrador fishermen we have entered, the interior is as dark and dismal, as forbidding and comfortless as can well be imagined, though this is not true of many of the homes of the Labrador folk.

Now the question arises, why may not this smooth, polished rock-surface have been made so by the floating ice borne down by the strong Labrador polar current, which flows past the coast at the rate of three or four knots an hour? That it had been done by land ice moving down the bay from the interior, we have been able to prove by our observations at "Indian Tickle," a deep, narrow fiord separated by a point of land from the northern side of Hamilton bay, or Invuctoke inlet. A "tickle," to use the language of the Labradorian, is any deep, narrow bay, just wide enough to admit of a vessel's passing through it. The shores of the Indian tickle presented much the same appearance, for here the Domino quartzite, very smoothly worn and polished, in places capped by trap overflows, runs under the water to the depth of about thirty feet, forming a polished and smooth bottom to the harbor. The marks we observed, and which proved conclusively to our mind the course taken by the ice, occur about twenty-five

feet above the water's edge, and below the line of lichens, which are probably kept at a distance by the sea spray.

Here on the polished and smooth shore, somewhat like that represented in Plate III, we observed a number of remarkable lunoid furrows (Fig. 1). These crescent-shaped depressions ran at exactly right angles to the course of the bay, and were from five to fourteen inches broad by three to nine inches long, and the depression was deepened in the hollow of the curve, for

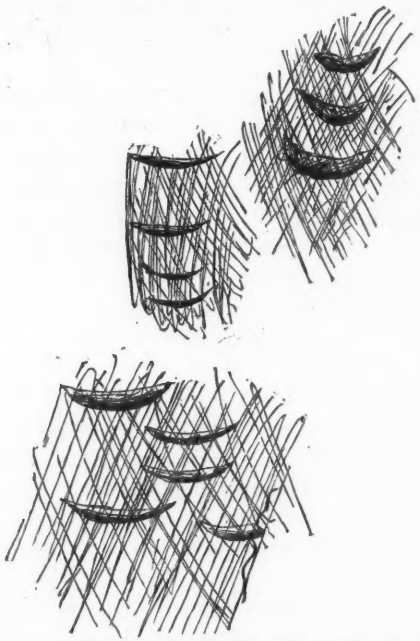

FIG. 1.—Glacial lunoid furrows at Indian Tickle, Labrador.

about an inch. Their inner, or concave, edge pointed south-west, the bay running in a general S. W. and N. E. direction. They were scattered irregularly over a surface twenty feet square. Where several followed in a line, two large ones were often succeeded by a couple one-quarter as large, or *vice versa*. Also at Tub island on the southern side of Hamilton bay, similar markings, though less distinct, occurred about the same distance above the sea, and on a similar polished quartzite.

These marks agree precisely with a number of lunoid furrows which I have observed on a shoulder of rock near the summit of

Mount Baldface, in the White mountains, which is 3600 feet high, and at other points in the White mountains, where I could observe the course of the ancient glaciers by trains of boulders and also by glacial grooves. These peculiar lunoid furrows are evidently made by rounded boulders freezing into the bottom of the glacier; the stone being thus frozen solidly into the ice, serves as a rude gouge, wearing out a crescent-shaped depression. The succession of several such furrows appears to be the result of the stone's slipping from the ice and turning over and becoming frozen in again during the advancing and receding motions of the glacier.

The presence, then, of these furrows is good evidence that the ice moved down the bay seaward. They could not have been made by floe ice, as the polar current flows along the coast at right angles to the direction of the bay, while it also appears that similar marks are abundant on the summits of some of the White mountain peaks. In a future paper I shall have more to say of glacial phenomena in Labrador.

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EDITORS' TABLE.

EDITORS: A. S. PACKARD, JR., AND E. D. COPE.

—— The intelligent press of the country is gradually adopting the position taken by the NATURALIST, in its August number, on the question of the insanity of Guiteau, the murderer of President Garfield. This is, that whether legally insane or not, the mental condition of the prisoner falls within the boundary-line of insanity.

This was simply an adaptation of the well known views of Herbert Spencer and Dr. Maudsley. It is to be hoped that a full investigation of Guiteau's case will lead to an important modification of the legal definition of insanity, and of the laws relative to the treatment of insane criminals. In the first place, the present definition, which only admits insanity where the criminal is unable to judge of the consequences of an act, is certainly erroneous. Persons undoubtedly insane often act with deliberate design, and great forethought. It would be a safe, though not a perfect definition of insanity, to describe it as a state of mind in which acts are committed, which are in direct opposition to the plain and obvious interests, not of persons affected by the act, but of

the actor. Here the question of the ignorance of consequences is restricted to its legitimate field, the instinct of self-preservation, through which the rational faculty has originated. It is another way of stating that the emotional or sentimental elements of character have so far overcome the rational as to cause the commission of self-destructive acts. Under this definition an act of violence committed in savage society would not indicate insanity, while the same act committed in civilized society, where means of detection and punishment abound, would be properly regarded as that of an insane person.

In such a classification, criminals are those who disregard the rights of person and property with a *reasonable* expectation of advancing their own interests thereby.

Benevolence is not an indication of insanity, for it is only a reflection of self-interest over others, and is often an expression of the most elevated form of self-interest. True reformers are not insane, but religious enthusiasts may easily be so. The former have a definite idea of practicable methods of advancing the true interests of mankind; while the methods, or aims, or both, of the insane enthusiasts, are at best useless and impracticable. But that the one class graduates into the other, is incontestible.

In the imposition of bodily restraint on the insane, reference will of course be had to the quality of the act, precisely as in the case of the sane. The nature of the act being established, the question now standing in the statutes as to the capacity of the criminal to comprehend the consequences of his acts, would well be considered. He who, with deliberate intent, violates the rights of person and property, is more dangerous to the community, than he who does so as an incidental effect of his aberrations.

The punishment of the former, should be like that of the sane criminal, designed to protect society in two ways; firstly by restraining the criminal himself from inflicting further injury; and secondly, by furnishing persons in the community of similar mental constitution with reasons for believing that it is contrary to their interests to commit like acts. In this way the law would furnish such insane with motives which would produce a change in the balance of the mind, the result being sanity. The punishment of death is as proper in such cases as in that of sane criminals of corresponding grade. The death penalty might even be necessary in the case of that lower grade of the insane who do not understand consequences. In this case the only object sought is the protection of the community, for motives are less operative with these than with the higher class of the insane. In either, the question of moral responsibility is omitted from consideration, as being beyond the range of human knowledge.—*C.*

—— The numbers of the AMERICAN NATURALIST for 1881 were issued on the following dates: January, December 31st, 1880;

February, January 25, 1881; March, February 24; April, March 25; May, April 16; June, May 19; July, June 22; August, July 27; September, August 23; October, September 23; November, October 28; December, December 3.

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RECENT LITERATURE.

MIVART'S THE CAT.[1]—The principle underlying the method of modern scientific, particularly biological study, is to examine one animal thoroughly, in order to lay the foundation for further advanced and more comparative studies. So we have books devoted wholly to the anatomy of a few common animals, typical forms, as the frog, the butterfly, or as in the present work, the cat. The tendency is thus to extreme analytical and special views, and such books should be of course used with the understanding that the student will never make a broad, philosophical naturalist unless his studies be made comparative. But it is better to thoroughly know all that can be learned from one kind of cat, than to have a superficial knowledge of cats in general, or mammals at large. Cats are very unequally distributed, and there is always a superfluity of material in our cities, so that the incipient medical student need not lack for material for dissection preliminary to his laboratory practice on the human cadaver. For this class of students this book is all important, while it is also designed for use in colleges and higher schools, or those beginning the study of zoölogy, as an introduction to the study of vertebrate animals.

After describing clearly and simply, with the aid of abundant and most excellent wood engravings, the skeleton, muscles, organs of alimentation, circulation, respiration and secretion, of reproduction, the nervous system, with the physiology of these organs in sufficient detail, a full and adequate account is given of the cat's development.

This important subject appears to be well treated, and is, in part, the result of the author's own observations, a number of the diagrams and illustrations having been prepared for this work.

These chapters occupy about two-thirds of the book, and are succeeded by chapters on the psychology of the cat, and on the different kinds of cats; while the work closes with essays on the cat's place in nature, the cat's "hexicology," or its relations to the world about it and to fossil cats, and finally, Professor Mivart gives us his opinions as to the pedigree and origin of the cat.

In his discussion of the nature of the cat's mind, the young student will be liable to be unduly biassed by Mr. Mivart's dog-

[1] *The Cat.* An introduction to the study of backboned Animals, especially Mammals. By ST. GEORGE MIVART, Ph.D., F.R.S. With 200 Illustrations. New York, Charles Scribner's Sons, 1881. 8vo. p. 557. $3.50.

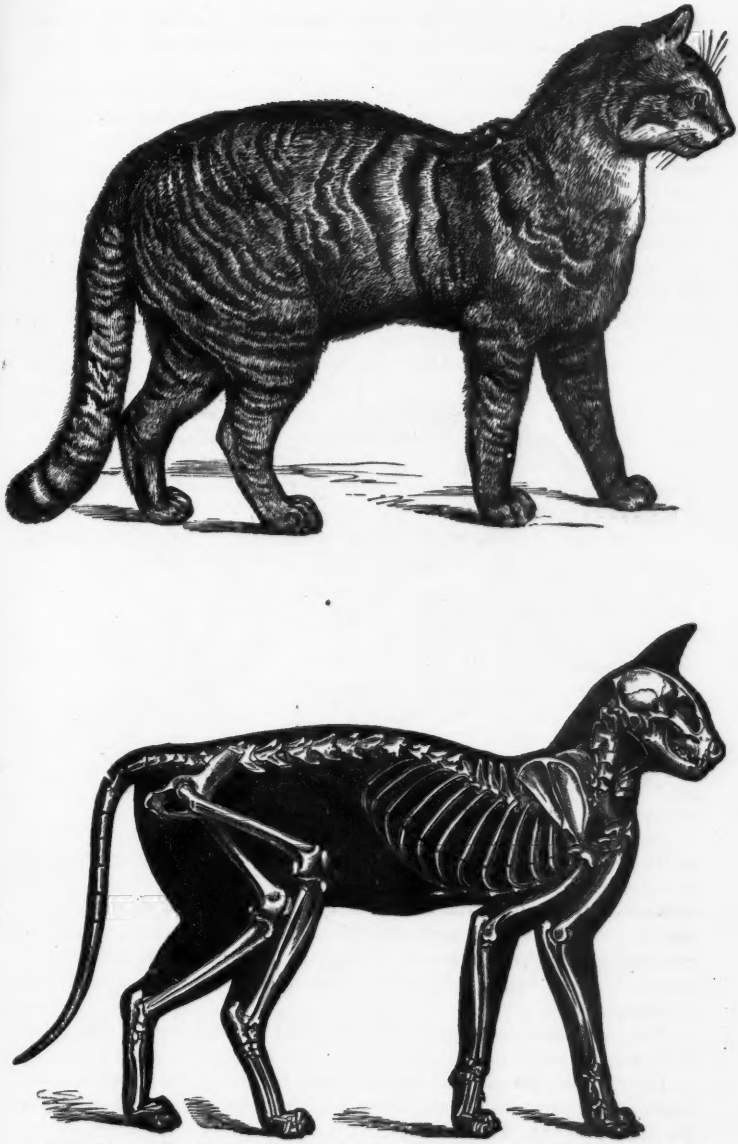
matic method of teaching a subject which needs great candor and liberality of thought, as there is a great difference of opinion among naturalists concerning the subject of animal psychology, and the student should, at the outset, know that the entire subject is unsettled, and that there are two predominant schools of thought. If he knows this, and that the matter may eventually be somewhat understood by future work, he will, perhaps, be led to make for himself new discoveries and observations on the habits and mental traits of animals, and gain clearer views of the entire field of comparative psychology. To make the *ex cathedra* statement that instinct is a "special faculty," or "a power of blindly performing appropriate complex acts, by seemingly voluntary actions in response to felt stimuli," and then in footnotes to attack what he deems the "very singular views" of Mr. Herbert Spencer and Mr. Lewes, as if they were alone in attempting to reason out the probable origin of instinctive acts; this, we contend, savors of dogmatism and onesidedness, and it seems to us that in an educational book of this sort both the old and the new views should be given to the student, who is supposed to have arrived at years of discretion, and to be able, in a degree, to judge for himself between conflicting theories.

Mr. Mivart also insists, as if it were a matter of course, that an animal "is really the theatre of some unifying power which synthesizes its varied activities, dominates its forces, and is a *principle of individuation.* There would seem to be here present, a vital force or principle which has no organ except that of the entire body within which it resides," etc. Now considering that a large number of biologists do not adhere to the old notion of a "vital force," we think the author should have stated both views fairly, giving in his adherence to whichever he may prefer. With the remaining portions of this chapter we agree, and the discussion concerning the nature of the cat's mind is a clear and interesting one.

Our domestic cat is probably a descendant of the old domestic cat of Egypt, which is mentioned in inscriptions as early as 1684 B.C., and was certainly domesticated in Egypt 1300 years before Christ. From Egypt the cat must have been introduced into Greece, while a fresco painting of a domestic cat was found on the wall of a Pompeiian house; although the late Professor Rolleston has suggested that the domestic cat of the Greeks was the white-breasted marten. The domestic cat is probably the descendant of the Egyptian cat *(Felis maniculata)*, a native of Northern Africa.

It is a pity that among the excellent drawings of different species of cats given us in this book, a good representation of the Egyptian cat should not appear.

In this chapter the different kinds of cats are described, and many of them illustrated in an excellent way, among them the



FIGS. 1, 2.—External form of Wild Cat and figure of the Skeleton, showing the relations of the latter to the external form.

wild cat of Europe, and the northern lynx, of which the North American *Felis canadensis*, *F. rufa* and *F. maculata* are considered as varieties.

There are, in Mivart's opinion, fifty species of living cats, but he thinks that some of these may turn out to be mere varieties, and some forms regarded in this book as varieties, may possibly prove to be really distinct species, especially when we consider the South American spotted cats, the ocelots and margays, as well as the smaller cats of China and neighboring regions.

The fossil species are then considered, especially those from the Tertiaries of France and North America, made known to us by Gervais, Filhol, Cope and Leidy.

In the discussion on the cat's place in nature, after a too long

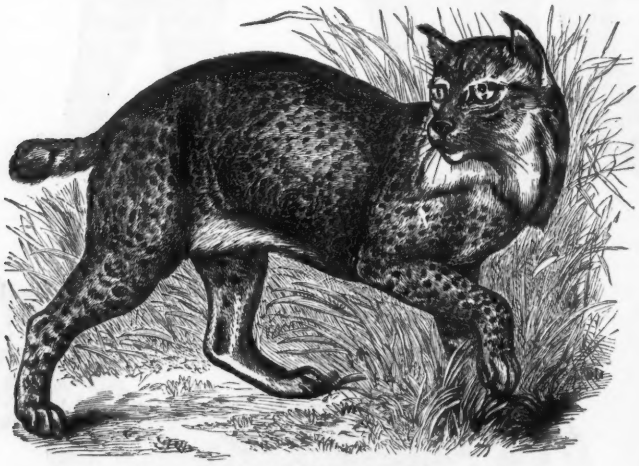


FIG. 3.—The Northern Lynx, var. *Felis maculata.*

effort to show that the cat is not a plant, but an animal and a carnivorous one, the author reasons by exclusion, and shows, what nobody will dispute, that the cat's place in nature is as "a member of the typical genus of the typical family of carnivorous placental mammals," mammals being what our author somewhat clumsily terms "the suck-giving, tied-brained class of back-boned animals."

The fourteenth chapter is on "the cat's hexicology." The gentle reader is here informed that this is not a new organ or quality of the cat, but simply is a word coined by the author and substituted for what seems to us a much better expression, the study of the environment. The study of all the "complex relations to time, space, physical forces, other organisms, and to surrounding conditions generally, constitute the science of *hexicology*." But if

the author is so far constrained, from motives of prudence in dealing with scientific names to the uninitiated as to use "backboned animals" for vertebrates, and the term "suck-giving" for mammalian, why does he take away the layman's breath by proposing the term *hexicology*, when we are only just getting used to the much better term environment?

But notwithstanding the formidable name at the head of the chapter, the essay itself is quite interesting, and serves to introduce us to the more valuable and interesting one on the pedigree and origin of the cat. In this essay all that has been learned of the cat's structure and development, and of cats and carnivora in general, is brought to bear upon the question of the origin of the species, and family, and order. In answer to these questions, the author, adopting the results of French and American palæontologists, states his belief that the cat has originated from the cheetah, and the Felidæ in general from some Viverrine animal, while the carnivora may have descended from *Arctocyon*, the oldest Tertiary mammal, and contrary to the views of some, our author derives the carnivora from the insectivora, rather than the marsupials. As to the method of evolution, Mivart stands out from most other English evolutionists as a believer in sudden or saltatory evolution as well as slow, gradual development of species, his views in a general way agreeing with those of several American writers on this subject. This last chapter is certainly an able and interesting discussion, and the entire volume is the work of an expert comparative anatomist, and of a strong, able, facile writer.

THOMAS' FIFTH REPORT ON THE INJURIOUS INSECTS OF ILLINOIS.[1] —In its typographical appearance, as well as general usefulness to the farmer or gardener, and interest to the entomologist, this report appears to us to be somewhat in advance of its predecessors. The longest article is on the army worm, and is a critical discussion of known facts regarding its natural history, some points of which still remain to be cleared up. Professor Thomas suggests as the result of his meteorological studies in connection with this insect and the chinch bug, that two favorable seasons are necessary to develop these insects in injurious numbers. The time is coming when by a study of climatic changes, we shall be able to predict, with some degree of certainty, the coming of injurious insects. This has already been in part worked out as regards the Rocky Mountain locust, and in this connection the suggestions and facts in the chapter of the present report on "the relation of meteorological conditions to insect development" is timely and valuable. Enough is now known of the periodicity in life of the more injurious insects to indicate that the Hessian

[1] *Tenth Report of the State Entomologist on the Noxious and Beneficial Insects of the State of Illinois.* Fifth Annual Report by CYRUS THOMAS, PH.D., State Entomologist. Springfield, 1881. 8vo, pp. 244.

fly is most abundant in rather wet and moderately warm seasons; while warmth appears to be the chief element in developing the Aphides or plant lice, some species being more favored by a humid atmosphere, while others develop more rapidly in a dry season. "The cut-worms are developed more abundantly in such seasons as increase the army-worms, which in their normal habits are but cut-worms, massing in armies and migrating being really an abnormal condition in their history. Observation shows, as heretofore stated, that, as a general rule, those species which occasionally develop in such vast numbers require for this purpose two consecutive seasons, though the character of the seasons for the different species differ somewhat. That is to say, those which bring out one species are not the ones which bring out another. As examples of the correctness of this statement I have only to refer to the migratory locusts, the chinch bug, as heretofore shown, the Hessian fly, the army-worm, etc. The locust and the chinch bug require the same kind of seasons, that is, two successive dry years, the latter warm as well as dry; consequently, when two such seasons prevail generally over the Northwest, both species are apt to appear, as was the case in 1874. But the case is different with the army-worm. This requires a dry summer and fall, and I am inclined to believe also a dry winter, followed by a cool and rather damp and cloudy spring. The two most noted years of its appearance in this State were 1861 and 1875, each of which followed a preceding dry year, but in neither case was the year in which it appeared warm, 1861 being one of average temperature, and 1875 rather cold. The latter, which is the only one for which we have the records of the different seasons, was more than usually damp in the spring and summer." Some meteorological tables are given in illustration.

These chapters are followed by a descriptive catalogue of larva; that of the caterpillars of butterflies being compiled by Miss Nettie Middleton, that of the Sphingidæ, Ægeridæ and Bombycidæ by Mr. John Marten, while a chapter giving original notes on caterpillars is contributed by M. D. W. Coquillet. The Report closes with a reprint of Bulletin 4. of the U. S. Entomological Commission on the Hessian fly, by A. S. Packard, Jr.

WALCOTT ON THE ORGANIZATION OF TRILOBITES.[1]—In this essay Mr. Walcott brings together the results of much patient labor in preparing sections and studying them with a view to settle the vexed question as to the nature of the limbs of the trilobite. The results are as follows: No antennæ have been discovered; but "four pairs of manducatory jaws, formed by the basal joints of the four anterior pairs of appendages," which "have a general structure similar to the cephalic legs of Limulus and Eurypterus."

[1] *The Trilobite:* New and old evidence relating to its organization. By C. D. WALCOTT. Bulletin of the Museum of Comparative Zoology at Harvard College, Vol. VIII, No. 10. Cambridge, March, 1881.

Mr. Walcott also feels "justified in stating that there is a series of jointed legs extending from the cephalic shield beneath the thorax and pygidium to the posterior segment of the latter; that, as far as known, they were ambulatory, and formed of six or seven joints; that to the basal joint there was attached an epipodite and branchia; and that, from the proof we now have, there is little doubt but that the appendages beneath the pygidium did not vary essentially from those of the thoracic region. They may have terminated in a slender filament, or filaments, as but three joints have been seen in any one appendage." We congratulate the author on the success of his long-continued efforts and well-directed labors; he has fully demonstrated that Trilobites have slender jointed limbs on the general plan of those of Limulus, and not phyllopodous ones; while he has also shown that the branchiæ were also attached to certain of these limbs, though we may not be satisfied with his interpretation of the nature of these gills, and wait for further light on this extremely difficult point. His restoration of a Trilobite will be useful, although it does not seem entirely natural, but yet may express the results of Mr. Walcott's work thus far. He has settled, however, in an admirable way, the general nature of the appendages of the Trilobite, and is entitled to the thanks of palæontologists.

RECENT BOOKS AND PAMPHLETS.—Herpetologische Bemerkungen vorzugsweise über Stüke des Naturhistorischen Museums in Bremen. Von Dr. J. G. Fischer, in Hamburg. Mit 3 Tafeln u. Abbildungen. 8vo, pp. 16, 4 plates, boards. Bremen, 1881. From the author.

Musée Teyler. Catalogue Systematique de la Collection Palaéontologique. Par T. C. Winkler. Quatrième Supplément. Roy. 8vo, pp. 38. Haarlem, 1881. From the author.

La Revue Scientifique, de la France et de L'étranger. Revue des Cours Scientifiques (3e Serie) Directeurs: MM. Antoine Breguet et Charles Richet. Paris, Octobre 29, 1881. From the directors.

Notice sur les Poissons Tertiaires de Céreste (Basses-Alpes). Par M. H. E. Sauvage. 8vo, pp. 22, 4 plates. Extrait du Bulletin de la Société Géologique de France. 3e serie, t. VIII, seance du 21 Juin, 1880. Paris, 1881. From the author.

Value of Degrees Baumé given by different authors. Compiled by C. F. Chandler and F. G. Wiechman. 1881. From the authors.

South America—Brazil. Bolivia. Madeira and Mamore Railroad. By Dr. Isaac T. Coates. 1881. From the author.

Proceedings of the United States National Museum. 8vo, pp. 16. Washington, Government Printing Office, 1881. From the museum.

Proceedings of the Academy of Natural Sciences of Philadelphia. 8vo, pp. 48. Philadelphia, 1881. From the society.

The Honey Ants of the Garden of the Gods, and the Occident Ants of the American plains. By Henry C. McCook, D.D. 8vo, pp. 180, 13 plates, bound. Philadelphia, 1881. From the author.

On certain Cretaceous Fossils from Arkansas and Colorado. By C. A. White. 8vo, pp. 6, 1 plate. Ext. from Proc. Nat. Mus., 1881. Washington 1881. From the author.

Extra Census Bulletin. The areas of the United States, the several States and Territories, and their counties. By Henry Gannett, E. M. 4to, pp. 20, map. Government Printing Office, Washington, 1881. From the author.

Illustrations of a Law of Evolution of Thought. By Joseph LeConte. 8vo, pp. 20. 1881. From the author.

The Kames of Maine. By George H. Stone. 8vo, pp. 38, map. 1880. From the author.

Medical Electricity. By S. V. Clevenger, M.D. 8vo, pp. 16, cuts. Reprint from the Chicago Medical Journal and Examiner, Nov. 1881. Chicago, 1881. From the author.

——.o.——

GENERAL NOTES.

BOTANY.[1]

MIMICRY IN FUNGI.—"Instances of mimicry are not rare amongst fungi. They are more frequently attractive than protective mimicries. They may be of vegetable, of animal, or of excrementitious substances, either as regards external appearance, or as regards odor. The main object of these mimicries is the attraction of insects, the advantages of which to plants are: (1), either fertilization of hymenomycetous spores by co-specific spermatia from other individuals, or by the transportation of spores from the hymenium of one fungus to that of another, or perhaps increased germinative energy to the spores is obtained by the admixture of other co-specific spores without the element of sexuality; (2), the diffusion of the fungus spores by insects as well as by the larger animals."—*Grevillea.*

SIMBLUM RUBESCENS GERARD, IN IOWA.—Two years ago W. R. Gerard described and figured a new species of fungus in the *Bulletin of the Torrey Botanical Club.* It was discovered on Long Island, and was found to be a species of Simblum, a genus of the Phalloidei, the Stink-horn family. No species of Simblum had previously been known to exist outside of the tropics, *S. periphragmoides* occurring in the Mauritius islands, *S. gracile* in Ceylon, *S. flavescens* in Java, *S. pilidiatum* and *S. sphærocephalum* in South America. Such being the distribution of the known species, it must be regarded as remarkable that one should be found in North America, and Mr. Gerard was justified in questioning whether his specimens might not have grown from spores or mycelium brought in ballast from the tropics, especially as we understand they were found at no great distance from "ballast dumpings."

This question is settled, however, by its discovery in Central Iowa in October of the past year. A dozen or more plants were found in a field by C. L. Spencer, a student in the Agricultural College. Good specimens were secured and placed in alcohol for study in the laboratory. In only one particular do the Iowa specimens disagree with the description given by Mr. Gerard. To our plant Schlechtendal's remark as to the odor of an allied species *does* apply very forcibly, for it certainly does "stink fürchterlich."

[1] Edited by PROF. C. E. BESSEY, Ames, Iowa.

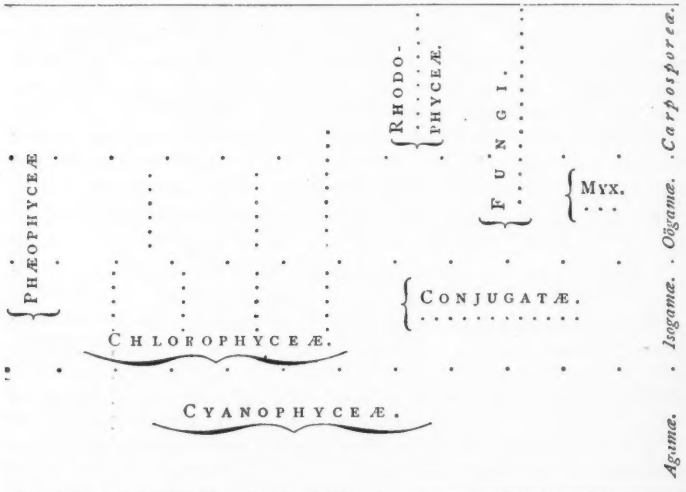
THE ASPARAGUS STEM FOR LABORATORY STUDY.—This plant affords as interesting and instructive an example of the stem of Monocotyledons as the now generally used pumpkin stem does of the Dicotyledons. It is so common that every botanical laboratory can be supplied with it, and its early appearance, and long-continued growth make it possible to secure fresh specimens during many months of the year. The new shoots, such as are sold in the markets, if placed in alcohol afford good material for study, although we have found it a better plan to make all the sections we wanted of fresh stems and then to preserve these sections in alcohol. Thus some cross and longitudinal sections of the very young stems we made early last year are still in most excellent condition for study. Not the least interesting feature of the asparagus stem is its provision for increasing its diameter by the subsequent formation of fibro-vascular bundles in a sub-cortical meristem zone. This will afford material for much careful study on the part of students in the laboratory.

THE ABUNDANCE OF FRESH-WATER ALGÆ.—The excessively wet autumn in Central Iowa caused an unusual growth of fresh-water Algæ. Every pond and ditch was filled with *Spirogyra, Zygnema, Vaucheria,* etc, until the first of November. Usually our waters are nearly barren of these growths so late in the season, but this year the continued wet weather, instead of the usual drouth, favored their development. The same causes doubtless produced the unusually large amount of autumn blooming of our spring flowers which was noticeable at the same time.

THE SYSTEMATIC ARRANGEMENT OF THE THALLOPHYTES.—If we except England and America, where a morbid conservatism seems to prevail, there has been a great deal of activity recently among botanists with reference to a better arrangement of the plants lying in the great region below the mosses, and to which Endlicher gave the name of the Thallophyta. Thus Cohn, in 1872, published in *Hedwigia,* an outline of a classification, in which the old groups Algæ, Fungi and Lichenes were no longer maintained in their integrity. Shortly afterwards (in 1873) Fischer proposed an arrangement which bears a striking similarity to Sachs'. These two are briefly given in our "Botany for High Schools and Colleges," and need not be repeated here. Sachs' now famous arrangement was published in the fourth edition of his *Lehrbuch,* which appeared in 1874. This has been somewhat modified by various authors, notably by Professor A. W. Bennett, who, in 1880, proposed to restore the groups (classes) Algæ and Fungi, subdividing them, however, into sub-classes by making use of Sachs' structural characters. This was republished in the NATURALIST for January, 1881.

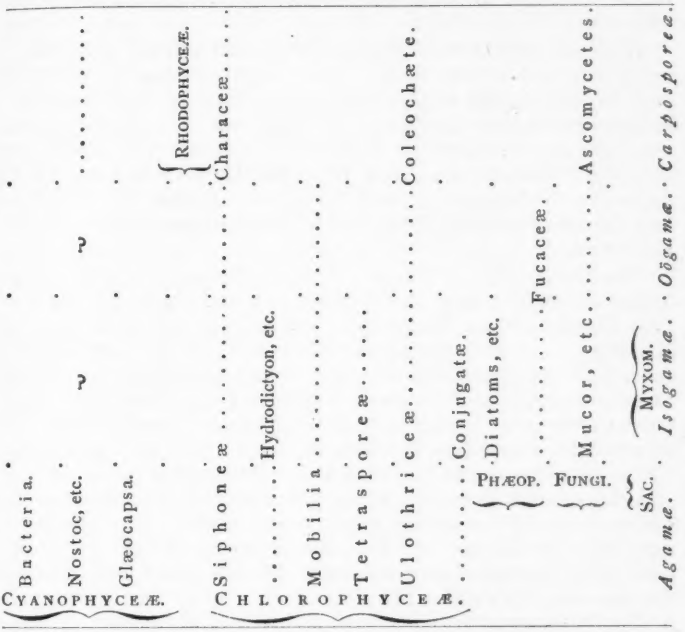
De Bary, in January of the present year, published in the *Botanische Zeitung* a scheme of a systematic arrangement of the

Thallophytes, involving some interesting points. In this seven classes, viz: the Cyanophyceæ, Chlorophyceæ, Conjugatæ, Phæophyceæ, Fungi, Myxomycetes and Rhodophyceæ, are recognized. These classes are regarded as genetic groups, which often include plants of very different structural rank. The Cyanophyceæ are thus all Agamæ, while the Chlorophyceæ are, for the greater part, Isogamæ, with three of its five branches extending into the Oögamæ, and one into the Carposporeæ. Phæophyceæ originating in the Isogamæ, extend into the Oögamæ; similarly the Fungi, which have their origin in the Oögamæ extend into the Carposporæ. The Conjugatæ are all Isogamæ, the Myxomycetes all Oögamæ, and the Rhodophyceæ all Carposporæ. Thus it is seen that De Bary has attempted to retain the integrity of the groups which European algologists have generally recognized, and at the same time to make use of Sachs' structural classification. It may be understood from the following diagram:



Cohn's later attempt was sketched in the June NATURALIST of the past year, and Caruel's in the October number. We have now another (*Bot. Zeitung.* Aug. 12, 1881) by Christoph Gobi, curator of the Herbarium of the University of St. Petersburg. This last bears a close resemblance to De Bary's in that Sachs' system is preserved for indicating structural rank; thus we have the Agamæ (Protophyta of Sachs), Isogamæ (Zygosporeæ of Sachs), Oögamæ (Oösporeæ of Sachs) and the Carposporeæ; further, the genetic series (or classes) include plants of different structural rank, the Cyanophyceæ being mostly Agamæ with a doubtful higher representation, the Rhodophyceæ all Carposporeæ, the

Chlorophyceæ and Fungi, each including the four structural forms, and the Phæophyceæ some Agamæ, Isogamæ and Oögamæ. The Saccharomycetes and Myxomycetes are outlying groups, respectively, of the agamic and isogamic Fungi. The following diagram will serve for comparison with the preceding one:



Gobi, after remarking upon the inappropriateness of the name Thallophyta, and the difficulty of fixing upon such characters as will set off distinctly the plants of this group from those of all others, suggests the new name of Glœophytæ, from the slimy nature of most of the species. We trust that this new name will not be adopted, for while there can be no exception taken to Gobi's criticisms upon the use of the term Thallophyta, the real difficulty lies in the attempt to combine in one great group, plants which have too many structural differences. In our opinion, the Thallophytes include several distinct grand divisions of the vegetable kingdom, just as the Cormophytes do. Old names generally live long after their usefulness has ceased, as witness Cryptogam, Endogen, Exogen, and in zoölogy the term Invertebrata, and doubtless it will be many years before we shall be rid of Thallophyta, but certainly we should not now add another to the long list of those which are to be forgotten.

It is significant that in all these recent attempts at a methodical disposition of these plants, the lichens do not appear as a distinct class, but are placed with the Ascomycetes (fungi), being regarded by most as an order of this class. This indicates the pretty general acceptance of Schwendener's views as to the nature of lichens, or, at the least, of some very considerable modification of the old view.

There are hopeful indications of a gradual settling down upon nearly the lines of demarkation first roughly drawn by Sachs. It may be that Sachs' names will not be retained, and, indeed, it may be questioned whether some of the more recently suggested ones are not preferable. However, we prefer Protophyta to Agamæ, while Isogamæ and Oögamæ are certainly not much preferable to Zygosporeæ and Oösporeæ. Zygophyta, Oöphyta and Carpophyta would be better in many respects than any yet suggested.

The Slime Moulds (Myxomycetes) sadly puzzle the botanists. Their old position near the puff-balls (in the Carposporeæ) they have hopelessly lost, while their right to a place in the Oösporeæ (De Bary) or the Zygosporeæ (Sachs and Gobi) is exceedingly doubtful. We agree with Fischer, Bennet and Caruel in placing them in or near the Protophyta. In view of Saville Kent's recent endeavor to show the animal nature of Slime Moulds, it may not be amiss to repeat here the remark made by us two years ago. "It is by no means an improbable hypothesis that in the Myxomycetes we have the *terrestrial phase* and in the Monera the *aquatic phase* of a common group of organisms. The Myxomycetes are not Monera, but they are moneran in their structure, and probably also in their affinities. All the differences between the Myxomycetes and a Moner like *Protomyxa*, for example, are probably referable to the terrestrial habit of the former as contrasted with the aquatic habit of the latter." ("Botany for High Schools and Colleges," p. 207, foot-note.)

In Bennett, De Bary and Gobi's systems the greatest emphasis is placed upon what may be called genetic relationship, as distinguished from structural relationship. That some account must be taken of genetic relationship in any system of classification needs no argument in these days, but this must not be to the exclusion of structure, and evident structural affinities, lest the prime object of all classification be defeated.—*C. E. Bessey.*

Electric Light and Plant Growth.—Dr. Siemens' interesting experiments with plants grown in electric light promise to be of great value not only to the student of vegetable physiology, but to the farmer and gardener as well. It seems to be pretty certain that in continuous light plants grow much more than when darkness alternates with light. Dr. Siemens is, indeed, led to ask whether the darkness of the night does not present a "difficulty to

plant life which had to be met," by a special development, instead of affording a period of needed rest. In fact, it begins to look as if the old notion of the need of rest by a plant would have to be abandoned, or at least very greatly modified. One of the most suggestive things brought out in these experiments is the blighting effect of the light from the naked electric light. Plants so exposed became shriveled and scorched, while those situated nearer to the light, but having a sheet of glass interposed, were not so affected.

BOTANICAL NOTES.—In Professor Parker's lecture on "Biology as an academical study," published in *Nature*, there is a most excellent denunciation of the teaching of botany and zoölogy as mere classificatory sciences, and a strong plea for the "laboratory method," which he properly urges for not only the college but for the high school also. "What," says he, "would be thought of a mathematical teacher who relied entirely on lectures, and never dreamed of insisting that his pupils should apply what he had taught by working out examples for themselves? Or what of a teacher of art who ignored the necessity of making his students draw or paint? Every one sees the necessity of practical, and the uselessness of exclusively theoretical teaching in these instances, yet the fact is generally ignored that the case is precisely the same with scientific subjects."——A good service has been rendered by the editor of the *American Monthly Microscopical Journal* in the publication in his journal of the Rev. W. Johnson's "Introduction to the study of lichens." Several wood-cuts help to make the matter so clear that the beginner need have no trouble in taking up the study of these very interesting plants. ——Mr. W. H. Leggett has seen reasons for suspecting cleistogamy in the common purslane *(Portulaca oleracea)*, and asks in the October *Torrey Bulletin* for confirmation or disproof.——As showing the incomplete state of our knowledge of the plants of the world, it is significant that *seven new species* of British lichens are described in *Grevillea* for September. If species are discoverable at that rate in a country which has been so diligently worked by collectors, what may we not look for in the world at large! ——Wm. Trelease has been studying the nectar glands upon the leaves of Populus, and finds that they appear as a rule only on the first half dozen leaves of each shoot in early spring. After a long series of careful examinations, the results of which he records in the November *Botanical Gazette*, he concludes that these glands are protective indirectly by attracting ants, ichneumonids and lady-birds, which in turn serve to keep off many harmful insects and larger animals.——From a study of the flora of Madagascar. J. G. Baker ventures in the *Journal of Botany* to estimate the number of species of flowering plants alone at from four to five thousand, a remarkably high number when we consider the limited area covered by it, viz: 228,573 square miles, or a little more

than three-fourths the size of the State of Texas.——Macchiati in the October *Nuovo Giornale Botanico Italiano* enumerates the orchids of Sardinia, forty-six species in all.——In the same journal, Professor Passerini continues his enumeration of the fungi of Parma. No less than thirty-two species of Peronosporeæ occur in the Parmensian flora.——The re-issue of the third series of the well-known *Botanical Magazine* is announced, by the publishers, L. Reeve & Co, London.——A second edition of Elliott's "Hand-book of Landscape Gardening" has appeared from the house of D. M. Dewey & Co., of Rochester. Botanically, its chief interest lies in the numerous very poor colored plates, the publisher has added. It is to be hoped that no horse-chestnut like the one figured in this book ever existed. There can be no excuse for such wretched plates, and for the numerous typographical blunders, which disfigure the work. However, we do not doubt, that the book may be useful to many who wish to improve their grounds.

ZOÖLOGY.

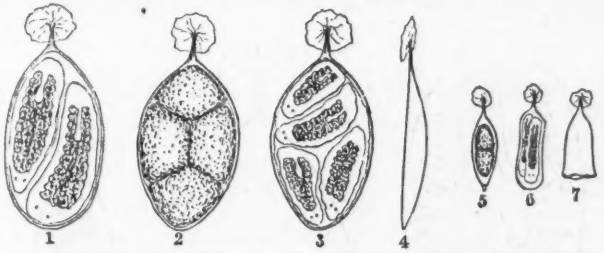
OBSERVATIONS ON THE SPECIES OF PLANARIANS PARASITIC ON LIMULUS.—During the present summer, while engaged in investigating food-fishes under the auspices of the U. S. Fish Commission, near the mouth of the Chesapeake bay, a fine large female specimen of *Limulus polyphemus* was brought to me from one of the pound nets near by, into which it had strayed. Upon making an investigation of the creature's anatomy, I discovered a great number of parasitic planarian worms infesting the gills, and adhering to the leaflets of the latter were many thousands of egg capsules, in which the young worms were undergoing development. From an inspection of a numerous series of these capsules, with the aid of the proper method of sectionizing, it would have been possible to have obtained a full history of the development of the species; for such an investigation the writer was not, however, prepared, nor did he have the time for it, but from the circumstance that there was a great diversity in the size of the capsules, he believes that at least three species of these parasites make the gills of the horse-shoe crabs their nidus. That such parasites infest this animal has apparently been known for a long time. Alexander Agassiz alludes to it under the name of *Planaria angulata* Müller, and Max Schultze in 1873, at Weisbaden, described the animal before the Congress of German Naturalists, but does not appear to have published anything in their transactions. Recently Dr. Ludwig Graff[1] has discussed the subject anew and at greater length and with more thoroughness; but he recognizes but one form, which he calls *Planaria limuli.* Dr. Graff's recognition of but one species is then the excuse for the present notice,

[1] Kurze Mittheilungen über fortgesetzte Turbellarienstudien. Zoolog. Anzeiger, II, Apr., 1879, pp. 202–205.

and I take the opportunity so offered of putting my observations upon record, so as to facilitate future studies by others.

Graff says the capsules observed by him in material supplied from the Frankfurt a. M. Aquarium, by Dr. Schmidt, measured about three millimeters long by one and a half wide, which would correspond pretty nearly with the outline of the largest capsule observed by me and represented in Fig. 9. But according to him these large capsules contained from two to nine embryos, while those observed by me never contained more than one, the presumption, therefore, is, that they belong to distinct species, and that on this specimen of Limulus, *Planaria limuli* was not present.

All of the capsules were apparently chitinous, and attached by a cylindrical stalk to the surface of the branchial leaflets by a disk-like expansion of the end of the stalk, as represented in

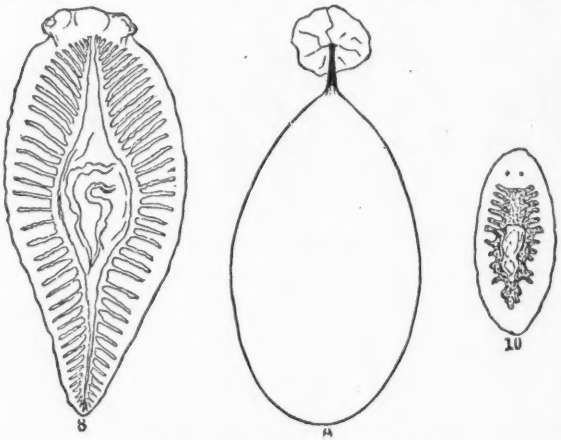


Capsules and Embryos of the Planaria of the Horse-shoe Crab; enlarged.

Figs. 1–7 and 9. In form the capsules are oval and flattened, lying down flat against the surface of the branchial leaflets with the plane side. The lower side of the capsule is flat, the upper convex, as shown in a side view, Fig. 4. When the young escape they find their way out by the free end of the capsule, which is ruptured as represented in Fig. 7. They are scattered all over the branchial leaflets and on both sides of them. The different sizes were often seen side by side on the same leaflets together with the parent worms, which, as Graff observes, had often eaten through the branchial structures. So extensive was this damage that I suspect they cannot be considered merely as commensals, but rather as true parasites, for it was frequently observed that four or five successive leaflets were eaten through in the vicinity of a large adult worm, so as to produce large irregular perforations with evidences of degeneration of the branchial tissues at the margins of the openings. That they should find it easy to feed off of their host is not to be wondered at, in that the branchial leaflets are composed of two very thin chitinous lamellæ which are kept apart by numerous rounded pillars; in the space between the lamellæ and around the supporting pillars the blood of the host circulates. In consequence of this arrangement, all that

our parasites need to do in order to get at the juices of their host, is to cut through the lamella next to them and they have an abundant supply of food always at hand. It appears that Van Beneden, the elder, regards them, on the authority of A. Agassiz, as messmates, but from the foregoing recital it would appear that they are more or less truly parasitic in habit. It appears that other crustaceans are infested by planarians, and Professor Leidy has described a parasitic genus, Bdellura.

On the specimen of Limulus examined by me there were three well-marked types of egg capsules. The first, represented in Figs. 1–4, enlarged sixteen times, measured about a twelfth of an inch, or about a line, in length, and usually contained from two to four embryos. The branches of the gastric cavity are separate posteriorly in the embryos, but afterward become joined, as shown in Fig. 10, supposed to be the adult of this second form This form has a pair of eye spots developed at a very early period



Parasite of the Horse-shoe Crab; enlarged.

which are retained when hatched. The mode of segmentation of the eggs is very difficult to make out in the capsules, as the individual ova are very strongly pigmented, and consequently almost opaque, so that the contours of the cells cannot be discerned.

The second form, represented in Figs. 5–7, enlarged sixteen times, is much smaller but similar in structural features to the preceding. The capsules measure about one-twenty-fifth of an inch in length, and contain usually two eggs or embryos. At first the ova occupy each one of the ends of the capsule, as shown in Fig. 5, but after the young worms have developed somewhat they usually lie along side of each other lengthwise of the capsule. They frequently change positions, however, at this

stage, and it sometimes happens that there is but one embryo in a capsule. The ova of this, like the preceding species are nearly opaque, and the walls of the stomach in like manner are composed of very dark granular protoplasm.

The next form of capsule observed, is that represented in Fig. 9, enlarged sixteen times, and is supposed to belong to the adult represented in Fig. 8, enlarged five and a half times. These, as stated before, were never seen to contain more than one embryo, and measure over an eighth of an inch in length. The egg is not so darkly pigmented as in the other forms. The supposed adult of this species, Fig. 8, is apparently without eyes, and the cæcal diverticula of the stomach are arranged in a paired system on either side of the median line independent of each other. The peculiar hood-like cephalic extremity may be of the nature of a sucking disk. This last form is milky white in appearance; the cæcal prolongations of the stomach, yellowish. The stomach in the other forms is dark brown, so that the two types of forms may be at once distinguished.

I do not propose to name the species, as these supposed distinct life histories may, after all our endeavors to separate them, be only phases of the same thing. Sure points of distinction can only be got by a more thorough study of these interesting types than I have been able to bestow upon them, and I leave them here in the hands of such helminthologists as may be disposed to give the subjects of this notice further attention.

I have not seen Dr. Graff's final paper, in which *P. limuli* was to be fully described and illustrated.—*John A. Ryder.*

The Circulation of Sessile-eyed Crustacea. — Dr. Yves Delage has published in the Archives de Zoologie expérimentale et générale, a superbly illustrated and detailed memoir on the circulation of the sessile-eyed Crustacea. The plates are printed in colors, so as to bring out clearly the heart, arteries, venous sinuses and veins; moreover, sections of the body are given, so that the topography of the circulatory system is given in a graphic manner. The memoir is too long for abstract, but it is one of the most valuable contributions of the past year to our knowledge of the Crustacea. The circulation appears to be on much the same plan as in the Decapods.

Viviparous Chirodota.—A Brazilian species of this genus of Holothurians, or sea-cucumbers, has been found by Professor H. Ludwig to be viviparous. The genital tubes appear to give rise to both eggs and spermatozoa, the latter being developed in their blind ends and lateral bunches. The young to the number of sixteen, and all of the same stage of development, were found lying freely in the body-cavity. They had seven tentacles, two of them minute, and in the body-wall were groups of developing or developed calcareous wheels.

A MARINE PLANARIAN AND ITS HABITATION.—In June, 1881, a very large female specimen of the common horse-shoe crab *(Limulus polyphemus)* came into my hands,[1] on the gills of which I observed a number of brown small bodies like seeds of some plant, together with living whitish worms, a dendrocœlous Planarian, the *Bdelloura candida* Girard.[2]

These worms were of various sizes, the largest (Fig. 1; side), measuring 16^{mm} in length and about 6^{mm} in width, by about 1^{mm} in thickness. They moved slowly and snail-like over the large lamellous gills, their body-margin, especially the anterior portion, having undulating motions, these being respiratory movements. On placing them in alcohol they became considerably wrinkled and contracted. The larger ones had neither cephalic notches (which occur in some members of this family), nor eye-dots. The dorsal side showed a faint line running along and close to the entire margin. A large round muscular bag occasionally protruded[3] from a little behind the middle of the ventral surface; this is the pharynx.

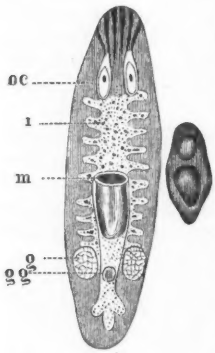


FIG. 1.—Young Planaria, 3mm long, extended. *oc*, eyes; *i*, alimentary system with lateral sacs; *m*, pharynx opening; *g*, male genital glands: *gg*, genital orifice. Figure at the side represents size and form of an adult Planaria.

In alcoholic specimens a second roundish smaller opening could be seen a little behind the pharynx, the genital orifice. The alimentary system had about ten or eleven lateral sacs.

The seed-like brown bodies found together with the Planarians, I immediately took for their egg-cases, which proved to be correct upon opening some of them whence one or two young Planarians could be taken. They were of a cream color and more transparent than their parents. But strange enough, they had a pair of distinct eye-dots, which, I presume, in the adult have degenerated.

The pharynx, the genital orifice and even the genital gland (Fig. 1 *g*) could be recognized. From analogy, I infer the latter to be the male organs, the female glands having escaped my observation, since our worm is hermaphroditic. The movements of these young worms were more rapid than in the older ones.

The egg-cases were of various sizes, by far the greatest number, however, being 3.50^{mm} in length (excluding the stem), by 1.50^{mm} in width. They were plano-convex, the latter exteriorly, the former towards the gills. They consisted of a brown, homo-

[1] From Theo. C. Hepp, M.D., Brooklyn, N. Y.
[2] Identified by Professor A. S. Packard, Jr.
[3] In alcoholic specimens in every case.

geneous, thick and leathery mass, either ovoid or cup-shaped, some of them having a sort of a lid on their tip.

Within many of them were the young Planarians, free, moving about, from one to three individuals in each capsule, in others the same were again enclosed within a similar oval case without stem, and again others were found with their tip broken off and empty. The greater number of them were covered around their tip with bluish (colorless in alcoholic specimens) ten-pin-shaped tubes with open tips. As these tubes were invariably on or near the tip of the capsules only, they cannot be taken for parasitic organisms, but may presumably be openings for an exchange of oxygenized water for the enclosed offspring. Those capsules having no such tubes, probably got them rubbed off through the motions of the gills of the Limulus. A few specimens of this Planarian, from three to five millimeters in length, the size usually found only within the capsules, were amongst the larger ones creeping around. These must have just left their protecting homes.—*Carl F. Gissler, Ph.D.*

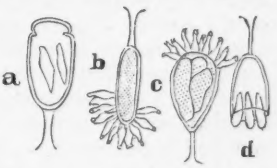


FIG. 2.—*a*, egg capsule with a lid, enclosing two encased embryos; *b*, egg-capsule with one free young enclosed, capsule with air-tubes (?) around tip; *c*, ordinary form of egg-capsule, enclosing three young Planarians; *d*, empty egg-capsule with three empty cases near orifice.

EYE OF PLANARIANS.—Professor R. Hertwig finds that the nervous system of these worms is very primitive in character, and is but slightly separated off from the surrounding tissue; in the eye it is possible to distinguish a black pigmented and a clear colorless portion. The former lies along the animal's axis; the latter is just below the epithelium, and is only separated from it by the basal membrane. The pigmented portion, again, consists of two parts, a transparent nucleus (vitreous body) and a superficial layer of surrounding pigment cells, which are only wanting at the diaphragm-like point at which the retina or colorless part is connected with the rest. The cylindrical fibers of the vitreous body are arranged parallel to one another, the nucleated ends being nearest the pigment. The retina is only formed of optic cells, which are continued at one end into a nerve-fiber, and at the other into a rod-like process. The fibers of the optic nerve traverse the retina in a very irregular manner, so that there is no regular arrangement of the optic cells.

THE STRUCTURE AND AFFINITIES OF THE HIPPOPOTAMUS.—In a recent illustrated paper, entitled "Observations upon the Hippopotamus," by Professor H. C. Chapman, published in the Proceedings of the Academy of Natural Sciences of Philadelphia, the author gives a résumé of what has been published upon the general anatomy of this animal, of which he dissected an adult male and female

of the ordinary *Hippopotamus amphibius*, which died during the year past in this country. He figures the brain, alimentary and reproductive systems, and adds much of importance to our knowledge of this great beast. In conclusion, he thus remarks on the natural affinities of the hippopotamus with the Ungulata and other mammals, especially the manatee. "In observing the manatee that lived for several months in the Philadelphia Zoölogical Garden, the manner in which it rose to the surface of the water to breathe reminded me often of the hippopotami that I watched in the Zoölogical Garden of London and the Jardin des Plantes in Paris. The slow way in which the animals rise to the surface, the motionless pose of the almost sunken body, the nostrils often just appearing at the surface, etc., are very much alike in both animals. In speaking of the alimentary canal, I called attention to the stomach of the manatee, which represents that of the hippopotamus in an atrophied condition, while, on the other hand, the stomach of the hippopotamus is intermediate between the peccary and the ruminants. As regards the heart, it will be remembered that in the young hippopotamus, at least, it is bifid, resembling in this respect that of the manatee. The female generative apparatus of the peccary and hippopotamus are almost identical. Again, the sexual vesicles are found in both hippopotamus and manatee. While the placenta does not appear to me to have the importance attached to it by some authors as a guide in determining the affinities of animals, it is proper to mention in this connection that according to Milne Edwards and Garrod the placenta of the hippopotamus is diffuse, and appears to be non-deciduous, and such is the case, according to Harting, in the dugong, and therefore in the manatee, probably, for, as a matter of fact, the placentation of the manatee is unknown.

"While the brain of the hippopotamus appears to be a modification of a type common to the pig, peccary, sheep, ox, giraffe, etc., it has also, it seems to me, affinities with that of the manatee. In a word, then, beginning with the pig, we pass by an easy transition to the peccary, which leads to the hippopotamus, and thence, in diverging lines, to the Ruminantia on the one hand, and the manatee on the other. Palæontologists have not discovered a form which bridges over the gap between the hippopotamus and the manatee, but it will be remembered that certain fossil bones, considered by Cuvier to have belonged to an extinct species of hippopotamus, *H. medius*, are regarded by Gervais as the remains of the *Halitherium fossile*, an extinct Sirenian, of which order the manatee is a living representative. According to Professor Owen, the molar teeth also, both in the Halitherium and the *Felsinotherium*, another Sirenian, are constructed on the same pattern as those of the hippopotamus. It is proper to mention, however, that the same distinguished observer considers the teeth of the manatee and the *Prorastomus*, another extinct Sirenian, to be rather allied

to those of the tapir and Lophiodon; but this qualification does not really invalidate the supposed affinities between the Sirenia and the hippopotamus. For the Artiodactyla and the Perissodactyla are probably offshoots of a common stock, and hence we may expect to find in these two groups certain characters common to both, inherited from their Lophiodon and Coryphodon-like ancestors. The affinities of the teeth of the manatee with those of the tapir—the first an embryonic Artiodactyle, the second a generalized Perissodactyle—would be examples of the above view. I do not mean to imply that the manatee has necessarily descended directly from the hippopotamus, though extinct intermediate forms may in the future show this to be so, for possibly they may be the descendants of a common ancestor. To many such speculations may appear mere waste of time, we being unable, from the nature of the case, to experimentally prove or disprove the truth of the hypothesis advanced. It seems to me, however, that the only explanation of the structure of the living forms and of the petrified remains of the animals referred to in these observations, is the hypothesis of there being some generic connection between them."

VERRILLIA BLAKEI OR HALIPTERIS BLAKEI.—In the San Francisco *Mining and Scientific Press*, of August 9th, 1873, I published a "Description of a new species of Alcyonoid Polyp, which I placed in Cuvier's genus Pavonaria, and gave to it the specific name of *blakei*, in recognition of the courtesy of Dr. James Blake, who kindly furnished the specimens to describe. Subsequently, nine days after the publication of the first description as above, at a meeting of the California Academy of Sciences, held on the 18th day of August, I removed the species to a new sub-genus which I called Verrillia, in honor of Professor Verrill, of Yale College.

The characters of this sub-genus were defined as follows: "Polypidon linear-elongate, round or ovate in cross section. Axis round, slender, bony; polyps arranged in two unilateral longitudinal series."

In *Nature* for November 6th, 1873, Dr. J. E. Gray, in an article entitled, "On the stick fish (*Osteocella septentrionalis*), and the habits of the sea pens," endeavored to make it appear that his genus and species, should have precedence, or the names so given by him should stand instead of mine, and gave what he called "the synonyma of these animals," presenting the sequence of dates of publication of the various papers, to show the priority of his own.

To this communication of Dr. Gray's I replied in a paper read before the California Academy of Sciences on the 16th of March, 1874, in which I reviewed the claims of Dr. Gray and his genus and species *Osteocella septentrionalis*, and denied the validity thereof, on the ground that "No description sufficiently accurate to be worthy of consideration can be made of the axial rods or bones alone, of this class of animal forms, nor can species be satisfac-

torily determined without the fleshy portion; nor in our present state of knowledge can the microscope determine these points."

In the *Zoölogical Record* for 1873, Vol. x (pp. 508–9), Dr. Lutkin, editor of the department Cœlenterata, uses the following language: "Its generic identity with the Australian species (type of Osteocella), cannot be established so long as the latter is known only from the axial skeleton."

It will be seen by the quotation that Dr. Lutken practically sustains my position.

My description, read before the Academy, August 18th, 1873, was soon after reprinted in the *American Journal of Science and Art*, to which Professor Verrill added a foot-note as follows: "A recent examination of a specimen, convinces me that this species is most nearly allied to the *Halipteris christii* Kölliker (Koren and Dar., sp.), and probably ought to be referred to the same genus."

While regretting that the generic title with which I had associated the name of a justly distinguished naturalist, as well as a personal friend, must yield to precedence, I can only accept his suggestion, and place the species in Kölliker's genus Halipterus. The allusions herein to the late Dr. Gray are not intended to revive any differences of opinion as between that eminent authority and myself, but are incidentally introduced, being necessary to the continuity of the record of my own connection with the form which furnishes the title to this paper.

I was not aware until recently that I had not already called the attention of the Academy to Professor Verrill's note, which long-continued sickness in my family, and the pressure, until very recently, of official duties caused me to overlook.—*R. E. C. Stearns, Berkely, California, Nov. 9, 1881.*

Discoveries of the U. S. Fish Commission on the Southern Coast of New England.—In the *American Journal of Science* for October, Professor Verrill records the further discoveries made the past summer over a region about 42 miles wide, north and south, and 105 miles long, along the 100-fathom line off the southern coast of New England. It will be remembered that a remarkably rich fauna inhabits this region, which is near the edge of the Gulf stream, and at the edge of the descent to the ocean bottom. This richness in life seems to be due to the following reasons stated by Verrill: This region is subject to the combined effects of the Gulf stream on one side, and the cold northern current on the other, together with the gradual decrease in temperature in proportion to the depth. It is, therefore, probable that, at any given depth below 50 fathoms, the temperature is nearly the same at all seasons of the year. Moreover, there is, in this region, an active circulation of the water at all times, due to the combined currents and tides. The successive zones of depth represent successively cooler climates, more perfectly here

than near the coast. The vast quantities of free-swimming animals continually brought northward by the Gulf stream, and filling the water, both at the surface and bottom, furnish an inexhaustible supply of food for many of the animals inhabiting the bottom, and probably, directly or indirectly to nearly all of them.

A very large species of Salpa, often five or six inches long, occurs, both at the surface and close to the bottom, in vast quantities. These are eaten by star-fishes, actiniæ, etc. Pteropods also frequently occur in the stomachs of star-fishes, while Foraminifera furnish a large part of the food of many of the mud-dwelling species. The fishes, which are very abundant, and of many species, of which the file-fish is the most notable, find a wonderfully abundant supply of most excellent food in the very numerous species of crabs, shrimps and other Crustacea, which occur in such vast quantities that, not unfrequently, many thousands of specimens of several species are taken in a single haul of the trawl. Cephalopods are also abundant, and are eagerly devoured by the larger fishes, while others prey largely upon the numerous gastropods and bivalves. Many interesting fishes and mollusks were taken, some new to science, and of great interest; among the latter, the most remarkable is a new species of the tropical shell *Dolium (D. bairdii)*, taken alive in 202 fathoms. *Dolium galea* extends northward to North Carolina. This southern form, with a large Marginella, an Avicula, and various other genera, more commonly found in southern waters, are curiously associated, in this region, with genera and species which have hitherto been regarded as exclusively northern, or even arctic; many of them having been first discovered in the waters of Greenland, Spitzbergen, Northern Norway, Jan Meyen Land, etc. A number of northern, mostly arctic, forms, not previously found south of Cape Cod, were also dredged.

Does the Crow Blackbird Eat Crayfish?—Professor Beal, of the Iowa Agricultural College, asks this question in the November Naturalist, his inquiry having been prompted by finding twenty-six gastroliths, or stomach-stones in a bird's "gizzard." The little incident which I will here record, I think will fairly settle this question with an affirmative answer. Crayfish inhabit many, doubtless most of the sloughs and wet places on our prairies; but I suppose the species to be identical with that in our rivers and streams, though they are sometimes spoken of as "land-crabs." Outside of where the water covers the ground, they dig holes into the soil, and in carrying out the dirt their holes are frequently built up like little chimneys, sometimes five or six inches above the surface. In a dry time they are compelled to descend so far, in order to keep in the water which is necessary to their existence, that they pass through our very deep black soil, and bring up the light-colored sand and fine gravel. In this way, they do a vast amount of work—generally, I believe, in

the night as they are seldom, if ever, seen so engaged. Passing a slough on the road, where these curious animals live, one day, three or four years ago, I saw a crow blackbird *(Quiscalus purpureus)*, very hard at work in an apparent effort to grasp some object on the ground. In a moment it flew up and alighted on a fence-post, having in its bill a quite large crayfish. The bird held it by the back, as a boy grasps one in his fingers, to keep clear of the creature's pinchings claws. The captor had evidently done that sort of thing before, for it manifested none of the awkwardness of a "new hand" at the business. During the moment which elapsed before the bird flew off with its prey, I could distinctly see the crayfish's legs and feet in rapid motion, as it was feeling about for some object to grasp, or struggling to escape. The bird seemed to have quite a job in mastering the bundle of claws and legs, but it appeared determined not to abandon its lucky "find." I believe this incident may be taken as a very positive answer to Professor Beal's inquiry, though in regard to the food of any of our birds we need just such crucial tests as those which have been made by Professor Forbes, of Normal, Illinois. As to the presence of such an unusual number of these gastroliths, in the bird's stomach, it would require close observation to determine whether they were picked up and swallowed as aids to digestion, in grinding up the food; or were left for the same purpose after the other portions of the crayfish had passed along into the intestines. But these sagacious and active birds are so often seen walking in the shallow water, that their mission is no doubt the capture of all sorts of "small deer" which abide in there, as minnows, crayfish, worms, small frogs, &c. They are wise birds, and they walk about within a few feet of an observer, with a degree of coolness and nonchalance which is as amusing as it is unusual in our feathered visitants. In spring and fall they industriously follow a plow all day long, devouring all sorts of insects, and at such times become exceedingly tame. In fact, their behavior is exactly of that kind to indicate that they take it for granted that no one desires to hurt them. At all events, that is the case on my farm.—*Charles Aldrich, Webster City, Iowa, Nov. 10, 1881.*

Wild Birds Racing with the Cars.—Several times I have noticed wild birds of different species flying along parallel with, and near a railroad train, in such a way as to suggest the idea that they were really trying to distance the iron horse! One day last spring I was coming east from Sioux City, Iowa, on the Illinois Central R. R., when my attention was attracted to a couple of birds which seemed to be making us a trial of their speed with the train. They were, as I supposed at the time, our smallest species of hawks—sharp, alert, powerful birds, possessed of a high degree of strength and endurance on the wing. They kept steadily on their course a dozen rods from

the train, for at least a mile and a half, but the train was too rapid for them, and they finally turned aside and went back in the direction whence they came. A strong head-wind was blowing at the time, and the birds at some moments seemed to sail squarely in its teeth without fluttering a wing. I watched them with much interest, and I did not think I could be mistaken in the belief that they were really trying to beat the train in the race. Horses and dogs frequently race with railroad trains, and possibly the instinct for sport and excitement may also exist in the wild birds.—*Charles Aldrich, Webster City, Iowa, Nov. 9, 1881.*

Infusoria in Dew.—Mr. W. S. Kent states, in his Manual of the Infusoria, that he gathered in a very foggy day in Regent's Park a quantity of grass saturated with "dew," and found in every drop squeezed from the grass great numbers of infusoria of different genera, such as Heteromita, Vorticella, etc., with *Rotifer vulgaris* and other rotifers, and numerous Amœbæ, Anguillula, and various diatoms, the collection as a whole being indistinguishable from the ordinary microscopic fauna of a roadside pond.

Zoological Notes.—The practical aspects of zoölogy must be appreciably felt in India, where it is reported that no fewer than 21,990 persons were killed during the year 1880 by snakes and tigers. The annual percentage of loss has increased during the past five years, the number of victims in 1876 not exceeding 19,273. It also appears that the white ant in India costs the government £100,000 a year for repairing wood-work, bridges, etc., caused by its depredations.——A preliminary report, by P. H. Carpenter, on the Comatulæ dredged by the U. S. Coast Survey, under the supervision of Mr. A. Agassiz, in the Gulf of Mexico, the Caribbean sea, and the east coast of the United States, appears in the Bulletin of the Cambridge Museum. The collection embraces forty new species of Comatulæ, the number known to inhabit the Caribbean sea alone being fifty-five; the genus being essentially a shoal-water one.——An additional case of supposed hybridity in birds is noticed by W. Brewster, in the Bulletin of the Nuttall Ornithological Club, for October. He thinks that *Helminthophaga leucobranchialis* and *H. lawrencei* are hybrids between *H. pinus* and *H. chrysoptera*. Hitherto it was not known to occur in any American birds, except among grouse and some of the swimming birds. Among the Passeres Trotter's hybrid swallow, and Ridgway's case of a supposed hybrid between *Helminthophaga pinus* and *Oporornis formosa*, have lately been added. Mr. Brewster thinks there are several additional doubtful species, which "show strong traces of a hybrid origin."——In the same journal, A. M. Frazer concludes that, instead of following the land, a large number of species migrate direct from Central America to the Mississippi valley, across the Gulf of Mexico, and the scarcity of these species in Southwestern Texas is thus

explained.——A new edition of Brehm's Thierleben, with 170 chromo-lithograph plates, is to be issued in 140 weekly parts, at 36 cents each, postpaid. B. Westermann & Co., of New York, are the agents in this country.——An annotated list of the birds of Nevada, by W. A. Hoffman, appears in the Bulletin of Hayden's U. S. Geological Survey, Vol. VI. It is prefaced by remarks on the distribution of vegetation in Nevada, as affecting that of the avi-fauna, and is accompanied by interesting profile views.——A valuable illustrated paper on the comparative anatomy and the histology of the brain, and more particularly of the *epiphysis cerebri* of Plagiostomes, Ganoids and Teleostei, by Dr. T. Th. Catter, gives us some apparently excellent drawings of the brains of *Raya clavata*, *Acanthias vulgata*, *Galeus canis*, *Acipenser sturio*, *Gadus morrhua*, *Cyclopterus lumpus*, and the common eel, which will be found very useful to naturalists in this country.——The *Zoölogischer Anzeiger*, for Nov. 14, contains a summary of new researches by Salensky, on the embryonal development of Salpa, and several articles on the intestinal worms.——Prof. Hæckel has gone to Ceylon on a scientific journey.——A new zoölogical station, to serve as a winter laboratory, and as an annex to the sea-side laboratory founded by Lacaze Duthiers at Roscoff, is to be opened at Banyuls-sur-Mer, on the Mediterranean. The building, says *Nature*, will be of considerable size, and the aquarium will be lighted by electricity.——An English adaptation of Claus' "Handbuch der Zoologie," by Mr. Adam Sedgwick, of Trinity College, Cambridge, with the addition of 500 to 600 drawings by Prof. Claus himself, is to be published by W. Swan, Sonnenschein & Co., London.——A hand-book of Vertebrate Dissection, by Prof. H. Newell Martin and William A. Moale, M. D., Part I, How to dissect a Chelonian, is announced as published by Macmillan & Co.

ENTOMOLOGY.[1]

On Some Curious Methods of Chalcid Pupation.—In the course of two years' study of the Chalcididæ, I have met with several anomalies connected with pupation, which seem to be worthy of description, and to which, so far as I can learn, with a single exception, the attention of entomologists has not been called.

One of the most curious of these instances, and one which has excited the greatest interest among my entomological friends to whom I have shown the specimens, is the case of a larva of *Phoxopteris divisana* Walk., an oak-feeding Tortricid, which has been parasited by an Euplectrus. The species I have called in MS. *E. albitrophis* and the method of pupation is so similar to that of *E. comstockii*, graphically described by Mr.

[1] This department is edited by Prof. C. V. Riley, Washington, D. C., to whom communications, books for notice, etc., should be sent.

Schwarz in the January, 1881, number of the NATURALIST, as to need no extended description. The flat, empty skin of the host is united to the leaf by a mesh of coarse silk, in which are placed transversely the seven parasitic pupæ, each separated from the others by a silken partition, and protected as by a roof by the skin of the Phoxopteris. Other lepidopterous larvæ will undoubtedly be found to be infested by parasites of this interesting genus, and the only wonder is that no observations should have been recorded since the days of Fonscolombe.

In early July, while examining the mines of *Lithocolletis hamadryadella*, on the white oak at Washington, several mines were found, each of which presented a discolored portion, regularly elliptical in form, 3.5^{mm} long by 2^{mm} wide, the edge of which was marked by a series of small, regularly placed black dots. Upon removing carefully the separated epidermis of the leaf, the center of the discolored portion was seen to be occupied by a naked Chalcid pupa, not fastened to the leaf in any way, but held in place and protected by a series of minute cylindrical pillars, from twelve to fifteen in number, applied by flattened extremities to the upper and lower surfaces of the mine, and forming a regular ellipse around the pupa. The distances between the pillars were uniform, and the pillars themselves were very constant in size. Their length was about 0.35^{mm}. The excrement of Chalcid larvæ, as is well-known, is only voided at the change to pupæ, and is usually to be found in a few irregular pellets at the anal end of the body of the pupa. These pillars, however, seem to be clearly excrementitious, and yet must have been formed by the Chalcid larva prior to pupation; but, as the anal end of the alimentary canal is only open during the transition to pupa, the material composing the pillars must have been expelled from the mouth of the larva, and shaped while yet moist. The most natural thought which suggests itself as to the object of this peculiar disposition of the excrement, is that the pillars by separating the floor and the roof of the mine save the pupa from the pressure of the latter, as the mine of *L. hamadryadella* is flat and not tentiform. If this be so, and no other reasonable explanation offers itself, it is certainly a most interesting and unlooked-for provision. The adult proved to belong to a brilliant little species of *Chrysocharis* Först, which I have called in MS. *C. singularis*.

While engaged one day in October in an oak wood, gathering galls with a view of breeding parasites, I found upon the under side of a leaf a curious assemblage of small black bodies, resembling, as much as anything I could think of, the excrement of some caterpillar. They were shapeless little objects, each mounted on end, and at the extremity of each, next the leaf, was a small racemose cluster of minute light gray globules. Without giving them a careful examination I settled it in my mind that the globules were the sporidia of some fungus which had settled upon

the excremental pellets as a matrix. With this view I stowed the leaf away in a pill-box, purposing to carry it to a mycological friend next day. On the following morning, however, I was greatly surprised to find that from several of my supposed excremental pellets had issued active little Chalcid flies. This of course led to a closer examination, and to the discovery that the supposed pellets were the bunchiest, most shapeless, most coarctate Chalcid pupæ I had ever seen. There were twenty-two of them in all, arranged around an irregular oval a centimeter long, the center of which had evidently, from the scattered hairs, once been occupied by the caterpillar upon which they had fed. Each pupa was fastened by its anal end to the leaf, and the clusters of light gray globules at the end of each, which I had taken for sporidia were nothing more than the contents of the alimentary canal, ejected before pupation. The surface of the leaf in the center of the oval space, round which the pupæ were clustered, was covered with a thin web of silk, which rendered the attachment of the pupæ to the leaf easier and firmer.

From these strange objects the adult Chalcids emerge by bursting off the upper portion of the pupa skin, leaving the separated part attached only by the sheaths of the posterior legs. The line of fracture extends behind the head and down caudo-ventrally, including the wing and leg sheaths in the separated portion. It has been suggested to me that the apparent want of form which these pupæ show—their extreme coarctation—could be explained on the supposition that the very delicate larval skin was not shed at all, but simply contracted closely around the pupa and its members as it formed. After softening the pupa, however, in various menstrua, the most careful examination showed no trace of such a skin. The strange form must rather be laid to some peculiarity in the secretion of the chitine.

Since this first experience I have several times found these interesting and sociable-looking little groups of pupæ upon oak leaves. The little mass of excremental globules at the end of each, by its decided contrast of color, adds much to the strangeness of the appearance. I have never found other trace of the host than the scattered hairs, which show it to be a bombycid larva. The Chalcid issuing normally from these pupæ is a species of the true genus *Eulophus;* but one is apt to be misled by the frequent presence of a secondary parasite—an *Astichus.* The latter, however, instead of issuing in the manner indicated above, makes its exit through a circular hole, cut usually in the thorax of the pupa. It is, moreover, a much smaller insect than the Eulophus.—*(To be continued.)*—*L. O. Howard.*

On the Oviposition of Prodoxus decipiens.[1]—In his paper treating of this insect, read at the Boston meeting, the author

[1] Abstract of a paper read by C. V. Riley at the Cincinnati meeting of the A. A. A. S.

stated that oviposition had not been observed. He has studied it carefully the past summer, and finds that, as the structure of the ovipositor would indicate, the female stations herself lengthwise with the axis of the stem, usually head upward, and literally saws through the epidermis with an up and down motion, just such as a carpenter would make in endeavoring to work the tip of an ordinary hand saw into the trunk of a tree. She never has anything to do with the stigma of the flower, as Pronuba does, and the important and interesting fact is recorded that the eggs of Prodoxus are all inserted while the stem is soft and before the flowers begin to open, *i. e.*, before Pronuba usually appears. As soon as the flowers begin to open (in *Yucca filamentosa*, the species upon which the observations were made) the stem has become too hard to permit the female to do her work, and the species has, for the most part, disappeared, only a few belated individuals being subsequently found, and these, so far as could be observed, perishing without issue. In experiments made to test the matter, it was found that where a female succeeded in inserting the ovipositor into a stem that had become hard, she perished in the effort to disengage herself, and remained firmly attached to the stem.

Clover Insects.—We have received an interesting brochure on the insects of the clover plant by Mr. Lintner, the State Entomologist of New York. After an introduction showing by quotations from Mr. George Geddes, the importance of the clover crop, especially to the people of New York State, he makes manifest the large increase of insect depredators on the plant. He then remarks upon the fact that no notice of clover insects appears in the reports of Dr. Fitch, his predecessor; which fact indicates the scarcity or the unimportance of the insects affecting the crop in Fitch's time. He next quotes from Kaltenbach's Pflanzenfeinde a list of sixty-six species affecting clover in Europe, and by way of comparison gives a list of our own species which includes thirty-three Lepidoptera, three Coleoptera, three Diptera, five Orthoptera and two Homoptera, and concludes with a detailed account of *Hylastes trifolii*, *Cecidomyia leguminicola*, *C. trifolii* and *Oscinis trifolii*.

It may be safely assumed that the number of species in this country affecting the plant, though not perhaps injuriously, will be at least doubled by future observation, and in Coleoptera we feel confident that it will be quintupled.

Horn's Classification of the Carabidæ.—A great deal of the classificatory work done by entomologists is based upon the study of isolated groups or of more or less restricted local faunas. Useful as such work may be, yet the complex relationships of forms; the true value of characters used for separating genera and higher groups; the coördination or subordination of characters, and other important classificatory questions, can be fully recog-

nized only by study of a whole family from all parts of the globe. Dr. Geo. H. Horn, whose excellent work on the Silphidæ was noticed not long since in these columns (p. 128), has just published in the Transactions of the American Entomological Society (vol. IX, pp. 91–196, plates III–X), an elaborate paper "On the genera of Carabidæ with special reference to the fauna of Boreal America." This is the first paper covering the general classification of this large family which has appeared since the publication of Lacordaire's first volume of his "Genera des Coléoptères" though a number of important papers by LeConte, Schaum and Chaudoir have contributed to our knowledge of the subject. Dr. Horn begins with a discussion of the characters of the Adephagous series of Coleoptera and divides them into seven families, the formation of the metasternum being of primary importance. The Haliplidæ, Amphizoidæ and Pelobiidæ are considered as families equivalent to the long established ones, viz: Cicindelidæ, Carabidæ, Dytiscidæ and Gyrinidæ. The Pseudomorphidæ, formerly looked upon as a distinct family, are made to constitute one of the three sub-families (Pseudomorphinæ) of Carabidæ, the two others being the Carabinæ and Harpalinæ, the bulk of the tribes and genera being embraced in the Harpalinæ. Tables and full expositions of the characters of the tribes of the whole family are then given, accompanied by tables of the genera occurring in our fauna. We cannot, in our limited space, treat of this important paper in detail; but if the student will compare the lucid and ingenious arrangement of the sub-family Harpalinæ, for instance, as given by Dr. Horn, with the former chaotic arrangements, he will be able to form an idea, not only of the immense amount of labor expended, but also of the excellency of the work. It is, perhaps, the most important of the several revisions the author has of late years given us—all of them so fresh, thorough and original, that it is a veritable pleasure to work by them.—*C. V. R.*

The Butterfly Trees of Monterey Again.—We gave in the July number of this magazine an abstract from a letter of Miss Jennie R. Bush, of San José, Cal., in reference to the so-called butterfly trees, near Monterey, of that State. From specimens sent some time ago by Miss Bush, we find that the butterfly in question is the cosmopolitan *Danais archippus*, which, as is well known, has a similar habit of congregating in immense numbers on trees in the Atlantic States, and does this during winter in the extreme Southeast (vide *American Entomologist*, Vol. III, p. 102). It was on the 27th of February that Miss Bush observed the phenomenon above related. The inference to be drawn from the interesting facts is, that the species finds on the Pacific slope, about the latitude 36° 30′, a climate congenial to its hibernation, whereas on the Atlantic side, it has to migrate southward so far as latitude 30°.

INTEREST FELT IN ECONOMIC ENTOMOLOGY IN CALIFORNIA.—The Board of State Horticultural Commissioners issued a call for a State Convention of fruit-growers, shippers, packers, nurserymen, and others interested in horticulture in California, to be held at the Senate Chamber, Sacramento, on Tuesday and Wednesday, the 6th and 7th of December, 1881, to commence at 10 o'clock, A. M. of the 6th, for the purpose of consultation and discussion of the most practical means of exterminating the insect pests, now infesting the orchards and gardens of that State; and such other subjects as may be introduced for the improvement of the fruit-growing industries of California. The Central Pacific Railroad Co. kindly allowed a two-thirds rate of fare from all their stations in California, to persons attending the convention, and issued instructions to their agents at all points in California, to sell tickets at a two-thirds rate of fare.

OBITUARY.—We regret exceedingly to have to record the death of Joseph Duncan Putnam, president of the Davenport Academy of Natural Science. He died on the 10th of December, at his home in Davenport, in the 27th year of his age, having been born in Jacksonville, Ills., Oct. 18, 1855. From boyhood, Mr. Putnam found fascination in the study of nature, and as he grew older, gave more and more attention to entomology. In 1872 and 1873 he traveled and collected in Colorado and Wyoming, in company with Dr. C. C. Parry. By the people of Davenport he will be most remembered for his unflagging efforts in behalf of the Academy of Sciences, which is so largely indebted to him. In entomology, his chief work was on the Coccids, and at the time of his death he was still deeply interested in the family, and in the Solpugidæ. Soon after his return from the West, in 1872, he contracted a severe cold, from the effects of which he never fully recovered. We first became acquainted with the deceased about that time, when he was greatly emaciated and racked by a very severe cough. Of late years he seemed to grow stronger, and get more free of his lung trouble, so that there was hope of prolonged life and usefulness for one who made friends of all whom he met, by a quiet modesty and lovable disposition, combined with diligent study, earnestness and enthusiasm, all the more remarkable, because of the physical suffering he struggled with. His bereaved family have our heartfelt condolence.

The announcement of the death of Count Georges Vandalia Mneszech, on Nov. 17th, at Paris, aged 58, has also just reached us through the editor of *Psyche*. He had one of the most extensive collections of Coleoptera in the world.

ANTHROPOLOGY.[1]

REVIEW OF RECENT WORKS ON ANTHROPOLOGY.—

Anthropology; an introduction to the study of Man and Civilization. By Edward B. Tylor, D.C.L., F.R.S., with illustrations. New York, D. Appleton & Co., 1881. 12mo, pp. 448.

The ancient Bronze Implements, Weapons and Ornaments of Great Britain and Ireland. By John Evans, D.C.L., LL.D., F.R.S., &c. New York, D. Appleton & Co., 1881. 8vo, pp. 509.

Primitive Industry; or Illustrations of the handiwork in stone, bone and clay of the native races of the Northern Atlantic seaboard of America. By Charles C. Abbott, M.D., etc. Salem, Mass., George A. Bates. Cincinnati, Robert Clarke & Co. 1881. 8vo, pp. 560.

Report upon United States Geographical Surveys west of the 100th meridian, in charge of First Lieut. Geo. M. Wheeler, Corps of Engineers, U. S. Army, under the direction of Brig. Gen. A. A. Humphreys, Chief of Engineers, U. S. Army. Published by authority of the Honorable the Secretary of War, in accordance with Acts of Congress of June 23, 1874, and Ferbuary 15, 1875, in seven volumes, accompanied by one topographical and one geological atlas. Vol VII—Archæology. Washington, Government Printing Office, 1879. [Special Titles, page VII and VIII.] 4to, pp. 497.

Anthropology is the application of scientific methods to the study of man—it is the natural history of the human race. In order to appreciate the merits and the defects of a scientific treatise, it is first necessary to have a clear conception of the extension and structure of the subject matter itself. Of anthropology the best idea can be conveyed by giving its subdivisions as they are understood by those most conversant with the subject, to wit:

1. *Hexicology* (Mivart).—The study of environment, inorganic, organic and social, in all its relations to our race.

2. *Anthropogeny* (Haeckel).—The discussion of man's origin with respect to place, time, zoölogic affinities and primitive condition.

3. *Archæology.*—Prehistoric and classical. The early history of mankind, including modern races still in the stone period.

4. *Biology of Man.*—The investigation of man's physical nature during its life-history, embracing anatomy, physiology and anthropometry, and compared with the evolution of lower forms.

5. *Comparative Psychology.*—The study of intelligence among all animated beings, and the comparison of the various races of men in this regard.

6. *Glottology.*—Research into the origin of language and of the various forms which it has assumed.

7. *Ethnology.*—The discussion of the origin and characteristics of the races of men. The description of races is ethnography.

8. *Comparative Technology.*—An examination of human arts as to their origin and the lines of their elaboration.

9. *Sociology.*—The study of society in the family, the community and the organized government. It includes the structure of

[1] Edited by Professor OTIS T. MASON, 1305 Q. street, N. W., Washington, D. C.

society, the function of its members as well as their processes and customs.

10. *Comparative Religion.*—The description of humanity in all its attitudes with reference to the soul, a future life, and spiritual beings related to man.

11. *Anthropological Apparatus.*—A science so comprehensive must have its instruments of precision, its museums and libraries, and its special works. No treatise upon the subject at large would be complete without an account of these instrumentalities.

With this analysis before us, it is not difficult to gauge the works under review. Tylor's Anthropology professes to cover the whole field. In this regard it not only enters into competition with older works, such as Waitz's Anthropology, and Klemm's Culturgeschicte, but with more recent publications, such as Peschels' Races of Men, Topinard's Anthropologie, and Quatrefages' L'Espéce Humaine. Each of these works has great merit, especially in those divisions of the subject wherein the author is a specialist. Peschel is an ethnologist, Topinard and Quatrefages are distinguished anatomists, Tylor has devoted his whole life to linguistics, technology, and comparative religion. In this work of the latter, therefore, we should reasonably expect to find the greater space given to these themes. In fact, Hexicology is almost totally neglected; Anthropogeny, Archæology, Biology and Ethnology are dismissed in the first three chapters of 113 pages; Glottology has chapters IV–VII, 68 pages; Technology, chapters VIII–XIII, 160 pages; Sociology, chapter XVI, 35 pages; and Comparative Religion, chapters XIV and XV, 58 pages. Furthermore, merit in this instance, has no relation to the number of pages, those subjects which are treated in a short space being very superficially handled, while those which occupy the greater part of the book show everywhere the hand of a master. Dr. Tylor is a pleasant writer, never dips his pen in gall, and never rushes into extremes. It would be no disparagement to the great number of anthropologists in England to say that Dr. Tylor was, of all, the best adapted to write this work. The book fills a decided gap in our scientific literature, and will, no doubt, find its way into the library of every one interested in the natural history of man.

The volume of Mr. Evans is of an entirely different character. It is a fraction of a fraction, as regards its subject matter, being a chapter in archæology, restricted in its area to Great Britain, and in the material described to bronze, in the widest acceptation of that term. For ten years Evans' Ancient Stone Implements, Weapons, and Ornaments of Great Britain, has been the Bible of archæologists. Whether we regard the analysis of the book, its typographic appearance, the beautiful cuts, or the wonderful nicety of description, it is well nigh faultless. The volume on bronze implements is a fit companion to the one just mentioned.

The introductory chapter reviews the history of bronze in the classical languages and touches upon the mooted question of an antecedent copper age. The rest of the work takes up in detail celts of various forms, chisels, gouges, hammers, sickles, knives, razors, daggers, spears, halberds, maces, swords, armor, trumpets, bells, pins, ornaments, and vessels. The great interest of the book, however, centers around the two closing chapters, relating to the methods employed by ancient bronze-workers, and the chronology and origin of bronze. The relation of Mr. Evans to modern archæological investigations as a cautious doubter, gives to all his utterances a credibility of the highest order.

Dr. C. C. Abbott has long been known as an indefatigable worker in archæology. For some years he has enjoyed exceptionable advantages as an associate curator of the Peabody Museum at Cambridge, Mass. Like the work of Dr. Evans, this volume is devoted to a part only of one of the subdivisions of anthropology, being restricted in area to the north-east Atlantic States, and in material to stone, bone and clay; but, like Dr. Evans in another respect, the author rambles frequently far from the Atlantic ocean, and even inserts a chapter on copper implements. The illustrations, like those in most American archæological works, not excepting some of the publications of the Smithsonian Institution, are, most of them, very poor, indeed. The great merit of the book is its adaptation to a very large class of intelligent people in our country, who are interested in local archæology, and would like to place themselves under the guidance of a skilled workman. For such persons Primitive Industry is valuable, though a little prolix. Practical archæologists will run rapidly over the volume until they come to chapters XXXII and XXXIII (the latter by Professor Henry Carvill Lewis), in order to hear Dr. Abbott's latest utterances upon the palæolithic implements of the Trenton gravels. This is his own peculiar province, and a subject worthy of the most careful scrutiny. In short, Dr. Abbott finds in the Trenton gravels, at a depth varying from three to forty feet, along-side of and beneath remains of the mastodon, "turtle-back" celts. The geological age of this deposit is unknown, but the implements are held to be veritable traces of a people who inhabited the northern Atlantic seaboard of America untold centuries prior to the advent of the Indian, or of Indians who reached our shores as far back as the glacial epoch.

Volume VII of the United States Geographical Surveys, west of the 100th meridian, is a joint production of F. W. Putnam, C. C. Abbott, S. S. Haldeman, H. C. Yarrow, H. W. Henshaw, Lucien Carr, and Albert S. Gatschet, in very unequal proportions, however, the greater part of it being the work of Prof. Putnam and Dr. Abbott. Several of the chapters are reproduced from Lieut. Wheeler's annual reports. Although a child of hope deferred, the imprint dating 1879, its parents have many reasons to be

proud of it. There are 22 plates, including the frontispiece and a map of the coast of Southern California; seventeen of these are heliotypes and very excellent, excepting those representing deep vessels, to which the process is not adapted. The remaining plates, front, XVI, XVII, XVIII, XIX, are beautiful colored lithographs, in whose praise too much cannot be said; the dancers in the front, we think, are much too light colored. This method of illustration is very expensive, however, and must be looked upon as the luxury of the science. The cuts, photo-relief drawings, though rude, are most of them, especially those representing rotundity, quite graphic. The great desideratum now is a method of depicting a great number of objects correctly at a moderate expense. Now, what is this volume about? The subject is graphically set forth by Dr. Yarrow, on pages 32–47. It is the description of a fortunate series of discoveries upon the main land and on the Santa Barbara islands opposite, in Southern California. These sites yielded a large and unique collection of crania and aboriginal implements which were subsequently placed in the hands of Prof. F. W. Putnam and his assistants at Cambridge to describe. Some of the chipped flints are of extreme delicacy of form and finish, well shown in the heliotypes but not in the cuts. The sandstone mortars occur in great abundance, are quite symmetrical, and some of them are massive; of these the cuts are excellent and the heliotypes bad. The most interesting stone implements are the steatite ollas, nearly spherical, thin-walled cooking vessels, having small opening or mouth. The method of manufacturing these vessels was discovered by Mr. Paul Schumacher (pp. 117–121). Curious pipes of the same material, resembling very large cigar-holders, were abundant in the graves, and were evidently used by the savage taking a siesta while lying supinely. Next in order come the perforated stones varying greatly in size, form, and consequently in function. Upon this chapter Prof. Putnam has put some excellent work, it is, indeed, one of the best in the volume. The closing chapters of Part I relate to implements of wood, shell, and bone, textile fabrics, ornaments and paint beads, contact with Europeans and crania. An appendix to Part I gives a translation of an account of Cabrilla's voyage, which is a precious addition to the meager stock of early literature relating to our west coast.

Part II relates to the Pueblo ruins and the interior tribes, and is made up of a series of short sketches, some of which are reproductions from former reports; it contains an extended chapter by Professor Putnam on the implements of stone, and pottery, collected mainly by Dr. H. C. Yarrow; a chapter on the crania collected by the expeditions, written by Mr. Severance and Dr. Yarrow; and an appendix on linguistics, prefaced by a classification of western Indian languages, by Albert S. Gatschet. The forty vocabularies belong to seven stocks: Tinné, Numa, Yuma, Rio

Grande Pueblos, Kera Pueblos, Wintún, Santa Barbara, and their area is given with great precision. The volume closes with tables of these 40 vocabularies, 211 words each, and additional notes and lists of very great value.

The space assigned to the works just noticed makes it necessary to give but a mention to the following meritorious publications:

The Madisonville Prehistoric Cemetery; Anthropological Notes. By F. W. Langdon, M.D., from the Journal of the Cincinnati Society of Natural History, Vol. IV., October, 1881, pp. 237–257.

Remarkable change in the color of the hair from light blonde to black in a patient while under treatment by Pilocarpin. By D. W. Prentiss, A.M., M.D. J. B. Lippincott & Co., Philadelphia, 1881, pp. 15.

Visitors' Guide to the Smithsonian Institution, National Museum, and Fish-Ponds. Edited by William J. Rhees. Judd & Detweiler, Washington, 1881, pp. 72.

Indian Names of Places, etc., in and on the borders of Connecticut, with interpretations of some of them. By J. Hammond Trumbull. Brown & Gross, Hartford, 1881, 8vo. pp. 93.

The distinguished name of the author as well as the great benefit to the future historian to be rendered by the publication of information which must be gathered now or never, are a sufficient guarantee of the lasting value of the last-named work.

ANTHROPOLOGY IN JAPAN.—The Transactions of the Asiatic Society of Japan, do not often reach us. Vol. IX, Part II, contains the following papers:

Edkins, Joseph, D.D., Contributions to the History of the Japanese transcription of Chinese sounds, pp. 107–124.

James, J. M., Descriptive Notes on the Rosaries (Jiu-Dzu), as used by the different sects of Buddhists in Japan, pp. 173–182.

Satow, Ernest, Ancient Japanese Rituals, Part III, pp. 183–211.

SNAKE SUPERSTITIONS OF THE PUEBLOS OF NEW MEXICO.—When I opened the old Turquoise mine at Bonanza, near Santa Fé, New Mexico, we found at least two hundred rattlesnakes of different kinds; also, long, thin red snakes, etc., etc., in it, all nesting together. We had four men in the shaft, two men excavating and two protecting the others from snakes, which crawled about in all directions (this was about eighteen months ago).

The Pueblo Indians came and protested, saying the mine belonged to Montezuma. They took the killed snakes most devoutly, and lamented their fate.

An Indian friend of mine told me that the snakes are servants of Montezuma. When an Indian wants to send a message to Montezuma, he catches a rattlesnake and carries it to the mine, being convinced that the bearer of the verbal notice will return to him one day with an answer. To this may be attributed the fact that certain old mines are filled with snakes. They were carried there by Indians.—*Dr. Fritzgærtner.*

GEOLOGY AND PALÆONTOLOGY.

THE OLDEST ARTIODACTYLE.—Members of this order have been found in the upper Eocene of N. America (*Achænodon*), but none have been determined as yet from the American Suessonian or lower Eocene. A species represented by teeth from the Siderolitic beds of Switzerland has been referred to *Dichobune* (*D. campichii* Pict); but dental characters alone are not sufficent to distinguish that genus from the Perissodactyle *Phenacodontidæ*[1]. Dr. Lemoine found astragali of a small Artiodactyle in the Suessonian of Reims, which he has recently ascribed to his *Lophiochœrus peroni*, which he believes (Proceedings French Assoc. Adv. Sci., Montpelier, 1880) to be a suilline. I have reported an astragalus from the Wind river formation of Wyoming Territory, which is almost exactly similar to those found by Lemoine. A specimen of *Mioclænus brachystomus* Cope now to be described, enables me to characterize with some degree of completeness this interesting form, which precedes in time all the known American *Artiodactyla*.

The characters of the tarsus are typically those of the Order *Artiodactyla*. The astragalus exhibits a distal trochlea which is continuous with the sustentacular facet, and which articulates with both cuboid and navicular bones.

The distal portion of the fibula is free from the tibia, and its shaft becomes very slender, but it is possible that a more perfect specimen would display it as continuous. Its distal extremity articulates with the ascending tuberosity of the calcaneum. The cuboid facet of the latter is narrow. The cuboid and navicular are distinct from each other and the cuneiforms; the mesocuneiform is shorter than the ectocuneiform, and *is coössified with it.*

There are probably four metatarsals. The median pair are distinct, but appressed; their section together, subcircular; the lateral metatarsals are slender, the external one is wanting, but its facet on the cuboid is very small.

These characters are in general similar to those of the genus *Dichobune*, but Cuvier[2] does not state whether the cuneiforms are coössified in that genus or not. They are united in *Anoplotherium*.

Mioclænus differs from *Dichobune* in the presence of but one internal tubercle of the superior molars, and in the single external tubercle of the superior premolars. Both genera are referable to a family to be distinguished from the *Anoplotheriidæ* by the presence of external digits. This has been already named by Gill the *Dichobunidæ*. The genus *Lophiochœrus* is not yet fully characterized, but its inferior true molars are very elongate and have their cusps connected by oblique ridges.—*E. D. Cope.*

[1] See AMERICAN NATURALIST, 1881, December.

[2] Ossemens fossiles, v, p. 183. Gaudry Enchainements d. Regne Animal, p. 147.

THE CHARACTERS OF THE TÆNIODONTA.—Additional material gives the following results with regard to the affinities of this suborder. There are three allied groups represented by the genera *Esthonyx*, *Tillotherium* and *Calamodon* of the American Eocenes which are equally unlike each other. *Esthonyx*, as I long since showed, is related to the existing *Erinaceus;* very nearly indeed if the dentition alone be considered. Its anterior incisor teeth are unusually developed and have, as in *Erinaceus*, long roots. One pair at least in the lower jaw has enamel on the external face only, and enjoys a considerable period of growth. The genus *Tillotherium* is (fide Marsh) quite near to *Esthonyx*. Its molars and premolars are identical in character with those of that genus, the only important difference being found in the incisors. Here, one pair above and one pair below, are faced with enamel in front only, and grow from persistent pulps as in the *Rodentia*. This character has been included by Marsh in those he ascribes to his "order" of *Tillodontia*, but as he includes *Esthonyx* in that order,[1] which does not possess the character, it is not very clear on what the supposed order reposes. The rodent character of the incisors is the only one I know of which distinguishes *Tillotherium* from the *Insectivora*. I have on this account retained the *Tillodonta* as a suborder, and referred *Esthonyx* to the *Insectivora*.

The *Tæniodonta* agree with the *Tillodonta* in the possession of a pair of inferior incisors of rodent character, but it adds several remarkable peculiarities. Chief among these is the character of the inferior canines. In the *Tillodonta* they are either wanting, as in *Erinaceus*, according to the Cuvierian diagnosis, or they are insignificant. In *Calamodon* they are of large size, and though not as long rooted as the second incisors, grow from persistent pulps. They have two enamel faces, the anterior and posterior, the former like the corresponding face of the rodent incisors. The function of the adult crown is that of a grinding tooth. This character distinguishes *Calamodon* as a form as different from *Tillotherium*, as the latter is from *Esthonyx*. There are, however, other characters. The external incisors, wanting in *Tillotherium*, are here largely developed, and though not growing from persistent pulps have but one, an external band-like enamel face. Their function is also that of grinders. The fact that the rodent teeth in the lower jaw are the second incisors, renders it probable that those of the *Tillodonta* hold the same position in the jaw. This is to be anticipated from the arrangement in *Esthonyx*, where the second inferior incisors are much larger than the first and third. The superior dentition of the *Tæniodonta* is unknown. There are two families, the *Ectoganidæ* with two species, and the *Calamodontidæ* with five species.—*E. D. Cope.*

[1] Report of U. S. Geol. Survey 40th Parallel by Clarence King, Vol. I, p. 377.

NEW FORMS OF CORYPHODONTIDÆ.—The Wasatch beds of the Big Horn basin have yielded several important additions to this family. Of eleven species found, two belong each to a new genus, and one is a novelty of the little-known genus *Metalophodon*. The characters of the genera of the family may be stated as follows:

I. Two internal cusps of the last superior molar.
All the true molars with a developed posterior external ∨ ..... *Manteodon*.
II. One internal lobe of the last superior molar.
a. Last superior molar with posterior external cusp.
Anterior two molars with posterior external ∨..... *Ectacodon*.
aa. Last superior molar without external posterior cusp.
†Anterior two molars with posterior external ∨.
Astragalus transverse, with internal hook ..... *Coryphodon*.
Astragalus subquadrate, without internal hook..... *Bathmodon*.
††First superior molar only with posterior external ∨..... *Metalophodon*.

The type of *Manteodon* is the *M. subquadratus*, which was about the size of an ox. The characters of its superior molars are more like those of Perissodactyles than are those of the other *Coryphodontidæ*. The type of *Ectacodon* is the *E. cinctus*, a species of about the dimensions of the last named. Its last superior molar is parallelogrammic, and has a cingulum all around it except on the external side. Of *Coryphodon*, a species larger than any yet known has been abundantly found by Mr. Wortman, which I call, in a paper now passing through the press, *C. anax*. The new *Metalophodon* is as large as the *Ectacodon cinctus*, and has the second true molar more triangular and less oval than in the type *M. armatus*. The posterior external ∨ of the last molar, is reduced to a cone. I have called it *M. testis*.—*E. D. Cope*.

AN ANTHROPOMORPHOUS LEMUR.—The stock from which the true quadrumana have been derived, is supposed to have been the lemurs, but no type of that sub-order has hitherto been found, which presents any near resemblance to either of the four families of monkeys. The two inferior families *Cebidæ* and *Hapalidæ*, agree with most of the *Lemuridæ* in having three premolar teeth, but those of the upper jaw generally have well developed internal lobes like the true molars, while most of those of the Lemurs have none. One group of Lemurs, the *Indrisinæ*, agree with the higher monkeys in having but two premolars, but these also are only one lobed.

A nearly perfect cranium of a species of *Anaptomorphus* Cope, shows that this genus had but two premolars in the superior series, as in the *Indrisinæ*, but that they are two lobed, as in the *Simiidæ* and *Hominidæ*. Of these two families, the *Hominidæ* is the one to which *Anaptomorphus* makes the nearest approach in dental characters. The canine is small with a crown little longer than those of the premolars, and is not separated from the latter or from the incisors by any appreciable diastema. All but one of the superior incisors are lost from the specimen, but those of the

lower jaw, which I discovered in 1872, were nearly erect as in man and the *Simiidæ*, and not procumbent as in most Lemurs. The cerebral hemispheres are remarkably large for an Eocene mammal, extending to between the middles of the orbits; the anterior parts, at least, are smooth. The cerebellum projected beyond the foramen magnum posteriorly, as in *Tarsius*. The orbits are large, approaching those of *Tarsius*, but are not so much walled in by a septum from the temporal fossa as in that genus. The superior molars have only one internal cusp.

The species, which I propose to call *Anaptomorphus homunculus*, has a wide palate much as in man, and the true molar teeth diminish in size posteriorly. The pterygoid and zygomatic fossæ are short and wide, and the petrous bone is large and inflated. The animal was nocturnal in its habits and was the size of a marmoset. The genus is nearer the hypothetical lemuroid ancestor of man than any yet discovered.—*E. D. Cope.*

The Archæan Rocks of Great Britain.—Professor Hull, director of the Geological Survey of Ireland, discriminates two petrographic types in the British Cambrian beds, the one consisting of purple sandstones or conglomerates, the other of hard green and purple grits and slates. The former is the "Caledonian" type, and is found in the north-west Highlands of Scotland. The second is the Hiberno-Cambrian, and characterizes East Ireland and North Wales. Professor Hull thinks these formations were deposited in distinct basins, which were separated by an Archæan ridge of crystalline rock which extended from Scandinavia, through the central Highlands of Scotland to Northwest Ireland. The Caledonian basin was an inland lake, the crystalline rocks of the outer Hebrides forming its western shore. Professor Hull also finds the Laurentian granite in N. W. Ireland overlaid unconformably by the Lower Silurian quartzite schists and limestones.—*Geological Magazine.*

A New British Formation.—The name Devono-Silurian is given by Professor E. Hull to a series of cotemporary deposits found in various parts of the British Isles, and to some extent on the continent. He finds them in Devonshire and on the Welsh borders, and probably concealed in Southeast England; also, in the south of Scotland and North and South Ireland. The beds were deposited under estuary or lacustrine conditions, and constitute a great group between the Silurian on the one hand, and the Devonian on the other.—*Geological Magazine.*

Recent Extinction of the Mastodon.—The existence of the mastodon in North America must have been more recent than commonly supposed. A number of new facts bearing on this subject are to be found in Professor John Collett's "Geological Report of Indiana for 1880," recently issued. Of the thirty individual specimens of the remains of the mastodon (*Mastodon giganteus*) found in Indiana, in almost every case a very considera-

ble part of the skeleton of each animal proved to be in a greater or less state of decay. The remains have always been discovered in marshes, ponds, or other miry places, indicating at once the cause of the death of the animal and the reason of the preservation of the bones from decay. Spots of ground in this condition are found at the summit of the glacial drift or in "old beds" of rivers which have adopted a shorter route and lower level; consequently, their date does not reach beyond the most recent changes of the earth's surface. In fact, their existence was so late that the only query is, says Professor Collett: Why did they become extinct? A skeleton was discovered in excavating the bed of the canal a few miles north of Covington, Fountain county, in wet peat. The teeth are in good preservation, and Mr. Perrin Kent states that when the larger bones were cut open the marrow, still preserved, was utilized by the bog-cutters to "grease" their boots, and that pieces of sperm-like substance, two and a-half inches to three inches in diameter (adipocere) occupied the place of the kidney fat of the monster. During the past summer of 1880 an almost complete skeleton of a mastodon was found six miles north-west from Hoopston, Iroquois county, Illinois, which goes far to settle definitely that it was not only a recent animal, but that it survived until the life and vegetation of to-day prevailed. The tusks formed each a full quarter of a circle, were nine feet long, twenty-two inches in circumference at the base, and in their water-soaked condition weighed one hundred and seventy-five pounds. The lower jaw was well preserved, with a full set of magnificent teeth, and is nearly three feet long. The teeth, as usual, were thickly enameled, and weighed each from four to five pounds. The leg-bones, when joined at the knee, made a total length of five and a-half feet, indicating that the animal was not less than eleven feet high, and from fifteen to sixteen feet from brow to rump. On inspecting the remains closely, a mass of fibrous, bark-like material was found between the ribs, filling the place of the animal's stomach. When carefully separated, it proved to be a crushed mass of herbs and grasses, similar to those which still grow in the vicinity. In the same bed of miry clay a multitude of small fresh-water and land shells were observed and collected. These were: 1, Pisidium, closely resembling *P. abditum* Haldeman; 2, *Valvata tricarinata* Say; 3, Valvata, resembling *V. striata;* 4, *Planorbis parvus* Say. These mollusks prevail all over the States of Illinois, Indiana and parts of Michigan, and show conclusively that, however other conditions may differ, the animal and vegetable life, and consequently climate, are the same now as when this mastodon sank in his grave of mire and clay.

The Mesozoic of Virginia.—Professor Fontaine gives a pretty full account of the geology of the Mesozoic of Virginia, with explanations of its peculiar features. He "has a very large collection of fine plants, many of them are new, and some

exceedingly fine. The collection is a pretty fair representation of the flora of the older Mesozoic, and will throw light on the Mesozoic of North Carolina and Pennsylvania. The secretary communicated the following notes by Professor Fontaine, made in the same letters: Upon the views of H. C. Lewis, respecting the Saltville valley in Southern Virginia, published in the Proceedings, No. 107, page 155. Mr. Fontaine points out that the little salt and gypsum bearing valley of Saltville cannot be "eroded along an anticlinal of Lower Silurian limestone, because the south-east wall hills only are of that age, while north-west wall hills are of the Umbral (Mauch Chunk or Sub-carboniferous) age." He was the first to find in the limestone on that side of the valley an abundance of Umbral fossils in the highly fossiliferous shale beds intercallated between the various limestones. The species are the same as those found near Lewisburg, West Virginia, in the Umbral. The magnesian (Lower Silurian) limestone strata, bounding the valleys on the south-west, show no trace of fossils. The physical aspect of the two formations also differs. Beds of shale and limestone alternate in the hills north-west of the valleys; and some of the limestone is cherty and some of the shales are red. But the south-east hills contain only solid limestone strata. Those on the north-west have a more rounded typography. It is, however, quite true that the stratification is in opposite south-east and north-west directions, gently to the south-east, much steeper to the north-west. The structure is, therefore, anticlinal, and this fault must run along the south-east edge of the little valley. The explanation is then simple, the Umbral limestone is synclinal, and the red shale formation comes up on both sides of it—with north-west dip in the little valley, with a south-east dip in the valley of the Holston river at the foot of the mountain. A reference to the place in the Michigan salt group in the Palæzoic series makes the presence of salt here easily understood. The horizon seems to be salt-bearing in other places in Southern Virginia. There is a salt ooze near Max Meadows, at the above geological horizon. The secretary suggested in addition to the underlying Vespertine (Pocono) sandstone is a salt-producing formation on the Ohio river and up country. That the gypsum is an acid reaction upon the eroded out-crops of the limestone, is shown in Proceedings A. P. S., Vol. IX, pp. 34, 1862. —*American Philosophical Society.*

GEOLOGICAL NEWS.—Messrs. Wachsmuth and Springer are publishing in the Proceedings of the Philadelphia Academy a revision of the *Palæocrinoidea* which will prove of great value to students. It is accompanied by numerous plates.——Professor Heilprin continues his researches on the Tertiary Geology of the Southeastern United States.——Edward Wethered, F.C.S., F.G.S., has communicated an important memoir on the formation of coal,

of which an abstract is given in the October, 1881, Geological Magazine of London.——The Bulletin of the Geological Society of France for 1881, contains many important memoirs, principally relating to the geology of France, Algiers and Belgium.——An analysis of the structure and age of the formations about Lake Champlain is given in the same periodical, by Professor Marcou. ——Dr. Lemoine has added many important discoveries to those he has previously made in the Lower Eocene near Reims, France. He has procured almost perfect skeletons of the Mammalian genera *Heteroborus*, *Pleuraspidotherium*, *Pachynolophus;* of the bird *Gastornis*, and the reptile *Champsosaurus*. He has also discovered a number of the Marsupial family *Plagiaulacidæ*, which is probably nearly allied to the *Ptilodus*, described from New Mexico in the November, 1881, NATURALIST.——Professor Newberry criticizes adversely Professor Spencer's view on the Ancient outlet of Lake Erie, published by the American Philosophical Society.

MINERALOGY.[1]

SYSTEMATIC MINERALOGY.—Bauerman. (Appleton & Co., New York, 1881.) The latest number of that excellent series known as the "Text-books of Science" consists of the first volume of a Text-book of Systematic Mineralogy, by H. Bauerman. The introduction states the two-fold object of the work to be that it should form (1) a guide to general students; (2) an elementary introduction to larger text-books. The greater part of the volume deals with the principles of crystallography. Not only are the simple and compound forms of the different systems fully described and illustrated, but by means of shaded figures, the origin of the hemihedral and tetartohedral modifications is explained. The optical properties of crystals are considered at length in some well written chapters, and the volume concludes with an elementary review of the physical and chemical characters of minerals. The descriptive portion of the work is not yet issued. We cannot help thinking that this work does not quite attain the object for which it was written. While not sufficiently thorough for the advanced student, the method of treatment is not such as would recommend it for the beginner. The language employed in a large portion of the book is by no means simple, and the practical performance of mineralogical work is but slightly considered.

LIME CRYSTALS IN A LIME-KILN.—Several years ago, Brugelmann succeeded in obtaining artificially microscopic cubes of

[1] Edited by Professor HENRY CARVILL LEWIS, Academy of Natural Sciences, Philadelphia. The Mineralogical Editor requests short original communications for publication in this department. Early copies of mineralogical papers printed elsewhere are also solicited for review.

lime by heating calcium nitrate. Recently Levalois and Meunier[1] have observed in the inner walls of a lime-kiln cubes of lime 5 centimeters in diameter. The crystals were sharp on the edges, and had the specific gravity of 3.3. Analysis showed that the crystals were composed of nearly pure anhydrous lime. They dissolved slowly in cold, but energetically in warm acids, giving out considerable heat. The crystals were formed upon the limestone walls of the kiln, which, with the exception of a few days, had been kept at a temperature of 1200°–1300° C. for over two years.

NITROBARITE.—Groth[2] describes a natural nitrate of Baryta from Chili. It occurs as small colorless octahedral crystals, with tetartohedral characters, belonging to the isometric system. Artificial crystals of nitrate of Baryta have a similar form. An appropriate mineralogical name for this mineral would be *Nitrobarite*.

VANADIUM MINERALS.—Within the last few years special attention has been directed to the natural occurrence of Vanadium and its compounds. It has been shown that Vanadium, formerly regarded as one of the rarest elements, is of widespread diffusion, and that it almost universally accompanies Titanium in the older geological formations. This fact acquires a cosmical importance when taken in connection with the observation of Lockyer that Vanadium exists with Titanium in the innermost portions of the photosphere of the sun.

Among recent investigations upon Vanadium minerals, those of Rammelsberg[3] are of great importance. He gives several new analyses, and after reviewing the Vanadium minerals, gives the following table of the natural vanadates:

Simple Vanadate	Dechenite $Pb\,V^2\,O^6$
Half Vanadate	Lead Vanadate from Wicklow and Wanlockhead $Pb^2\,V^2\,O^7$
Third Vanadates	Eusynchite $(Pb, Zn)^3\,V^2\,O^8$
	Arāoxene $(Pb, Zn)^3\,(V, As)^2\,O^8$
	Vanadinite $Pb\,Cl^2 + 3\,Pb^3\,V^2\,O^8$
	Pucherite $Bi^2\,V^2\,O^8$
Quarter Vanadates	Descloizite $(Pb, Zn)^4\,V^2\,O^9 + aq$
	Volborthite (Friedrichsrohe) $(Cu, Ca)^4\,V^2\,O^9 + aq$
Of uncertain composition	Psittacinite $(Pb, Cu)^5\,V^4\,O^{19} + 9\,aq$
	Mottramite $(Cu, Pb, Ca)^6\,V^2\,O^{11} + 2\,aq$
	Volborthite (Perm) $R^8\,V^2\,O^{19} + 24\,aq$

Websky[4] and Urba[5] have investigated the crystalline forms of Descloizite and Vanadinite. Websky describes pseudomorphs of Vanadinite after Anglesite.

[1] Compt. Rend., 90, 1566, June, 1880.
[2] Zeits. f. Kryst., 1881. VI, 195.
[3] On the composition of Descloizite and the natural Vanadium compounds. Monatsber. d. k. Ak. Wiss. Berlin. July, 1880, p. 652.
[4] Monatsb. d. k. Ak. Wiss. Berlin, July, 1880, p. 672. Oct., 1880.
[5] Zeits. f. Kryst., 1880, p. 353.

In America, our knowledge of Vanadium minerals has been largely increased by the important papers of Genth.[1] Vanadium has been shown by the editor to occur in the Philadelphia gneisses.[2] More recently Silliman[3] has announced the discovery of two important localities for Vanadium minerals in Arizona. He states that very beautiful and perfect orange-red and yellow crystals of Vanadinite have been found in that State. He also describes Vanadium minerals which he believes to be Descloizite and Volborthite. Chileite and Mottramite are also suspected. It is to be hoped that a more exact chemical and crystallographic examination may be made upon these interesting minerals.

MICROLITE FROM VIRIGNIA.—Very fine and large crystals of this rare mineral have been found in Amelia Co., Virginia.[4] The crystals are octahedrons modified by cubic, dodecahedral and sometimes also trapezohedral planes. Some of these crystals which have been brought to Philadelphia are several inches in diameter, and we have seen masses of the mineral weighing as much as thirty pounds; a circumstance rendering the name of the mineral an inappropriate one. The mineral is of a wax yellow or brown color, and has a resinous lustre and conchoidal fracture.

Amelia county has become a remarkable mineral locality. It has yielded also Beryl, Fluorite, Columbite, Amethyst, Apatite, and Tourmaline. We have seen a beryl from there which was a perfect hexagon with sharp edges, measuring nine inches in diameter by over two and a half feet in length. The interesting variety of quartz which occurs in the Amelia county muscovite as minute circular plates composed of radiating fibres is already known to microscopists as a most beautiful object for the polariscope.

DIADOCHITE, a phosphato-sulphate of iron has been found in some French anthracite coal mines. It occurs as amorphous brown crusts of resinous lustre. It should be looked for in the coal mines of this country.

VIVIANITE has been produced artificially by fusing a salt of iron with bone black.

ROSTERITE is a variety of beryl from Elba, of a light rose red color. It occurs in short hexagonal tables.

URANOTHORITE is a Thorite from the Lake Champlain Iron district, containing much Uranic oxide.

BEAUXITE, according to Fischer, is a mixture of oxide of iron and red clay.

[1] Amer. Journ. Sc., July, 1876, p. 32. Proc. Amer. Philos. Soc., XVII, 113.
[2] Proc. Acad. Nat. Sc., Phila., 1880, 256.
[3] Amer. Jour. Sc. XXII. 198. Sep. 1881.
[4] Dunnington. Amer. Chem. Journ., III, 2. 130.

BERGAMASKITE.—A variety of amphibole. Lucchetti[1] describes under this name a variety of hornblende from Italy, which contains almost no magnesia. It occurs in green acicular crystals with the following composition: SiO_2 36.8 FeO 22.9 Fe_2O_3 14.5 Al_2O_3 15.1 CaO 5.1 MgO 0.9 Na_2O 4. K_2O 0.4.

NEW BISMUTH MINERALS.—Domeyko[2] has described a large number of interesting Bismuth minerals from South America. Among them are *Bolivite*, an oxysulphide of bismuth ($Bi^2S^2 + Bi^2O^3$) and *Taznite*, a chloro-arseniate and chloro-antimoniate of Bismuth. Bolivite occurs crystallized. Taznite is amorphous and sometimes imperfectly fibrous.

THE OPTICAL PROPERTIES OF PYROMORPHITE AND MIMETITE.—Jannetez and Michel[3] in a paper comparing the optical and chemical properties of pyromorphite and the mimetite find that these minerals can be divided into four types; (1) pure pyromorphite, uniaxial, (2) pure mimetite, biaxial, (3) mixtures showing pyromorphite in the centre, surrounded by mimetite, part uniaxial, part biaxial, (4) groups of crystals having their axes inclined to one another, biaxial appearance.

CHALCOCITE ON AN OLD COIN.—Upon some bronze Roman coins found at the bottom of a French lake, Daubree[4] has observed an incrustation, 2^{mm} in thickness, of chalcocite. The chalcocite forms hexagonal plates like the cupreine of Breithaupt. Some chalcopyrite and malachite were also formed. While similar incrustations are common in thermal springs and mineral waters, the present case is interesting in that the water was cold and pure.

NOVA SCOTIA MINERALS.—Among other minerals found in the trap of Nova Scotia, Gilpin[5] mentions Chlorophœite, Delessite, Acadialite, Mordenite, Louisite, Ledererite, Gyrolite, Centrallasite, Cyanolite, Steelite, etc. He regards Louisite as a variety of Okenite, and Steelite as a variety of Mordenite.

GEOGRAPHY AND TRAVELS.[6]

M. DE BRAZZA'S JOURNEY FROM THE OGOWE TO THE CONGO.—Some further details of M. de Brazza's journey are given in the Royal Geographical Society's *Proceedings* for November, 1881. "After leaving his station at Francheville in July, 1880, the traveler saw the sources of the Passa affluent of the Upper Ogowé, and crossed the River Lekéti (an affluent of the Alima, the Kunia

[1] Mem. Ac. Sci. Bologna, 1881, 2, 397.
[2] Ann. d. Min., XVIII, 538.
[3] Bull. Soc. Min. de France, 1881, 196.
[4] Comp. Rend., XCIII. 572. Oct., 1881.
[5] Proc. and Trans. N. S. Inst. Nat. Sc., V, 283.
[6] Edited by ELLIS H. YARNALL, Philadelphia.

of Mr. Stanley's map), which appears to have been misnamed M'pama in the map of his previous journey, by this route reaching the navigable portion of the Alima in four days. It is thought probable that the plateau of the Batékés reaches to the right bank of the Upper Ogowé, and is connected with that of the Bayakas, in which, perhaps, the River Ngunié, which joins the Ogowé below Lambaréné, takes its rise. The plateau of the Batékés (Achicuyos) separates the Alima from the M'pama (the M'paka of Mr. Stanley), which probably rises in the plateau of the Balalis, flowing direct to the Congo. Leaving the plateau of the Batékés (Achicuyos) by the M'pama, M. de Brazza arrived at the plateau of the Abomas, which is well peopled and very fertile, and separates the M'pama from the Lefini (the River Lawson of Mr. Stanley). On leaving the plateau of the Abomas M. de Brazza was assured that he could reach Stanley Pool on the Congo in four days, by way of the plateau of the Makokos, but he thought it advisable to change his route, in order to enter into negotiations with the Ubangi tribe, with whom he had had previous difficulties. He afterwards descended the Lefini on a raft to within a day's journey of its confluence with the Congo. He then marched by land, with only five attendants, in two days, to the Congo, which he reached near to a populous part of the Ubangi country. He was received by the chief Ngampéi, who is subject to the Makokos, and arranged with him to make certain propositions to the Ubangis. Without waiting for the result of this step, he returned to the Lefini, and in two days' time reached the plateau of Makoko, to whom all the country is subject between the Lefini, the Jué (Zué of Mr. Crudgington, and Gordon Bennett of Mr. Stanley), and the Congo. Makoko assembled all the chiefs of the Ubangis, from the Alima, the Bakinga (the Likuma or Likona of the old maps), and the Ikelemba and through his influence peace was made with M. de Brazza. Makoko then sent two chiefs down with him by canoe to the spot ceded for the Brazzaville station, near Stanley Pool. Whilst there, M. de Brazza explored the road from the village of N'gamforu, chief of the Abomas, to the River Kunia, across the plateau of the Makokos; and he considers that the principal difficulties to be met with on the road from Francheville to Stanley Pool would be the passage of the Rivers Leketi, M'pama, and Lefini."

CENTRAL AFRICA.—The African traveler, Dr. Enim Bey, believes there are three lakes lying to the north of the Victoria Nyanza. Beatrice Gulf certainly does not belong to the Albert Nyanza, but to a lake south of the Albert. Steamers now go regularly from Dufilé to Mahagé, a station on the west coast of Lake Albert.——At the beginning of the present year Mr. J. M. Schuver left Cairo with the intention of traversing Africa from north to south. When last heard from he was on his way to

Fadasi near the Yabos affluent of the Blue Nile in about E. long. 35° 10′ N. lat. 9°. He expected to return to Fazogl and journey through the Galla country after the rainy season was over. In this stage of his great journey Mr. Schuver's chief objects are stated to be the determination of the sources of the Sobat and the discovery of the lakes, which are believed to exist on the high plateau between the White Nile and Kaffa.——Mr. Joseph Thomson has recently been exploring the Loende tributary of the Roouma River. No coal was found. The whole country is thickly covered with forest composed chiefly of India rubber trees. The land rises immediately from the shores of the Indian Ocean to an altitude of three hundred feet, and gradually an elevation of three thousand feet is attained. Mr. Thomson now intends to visit the region lying between the sea and Mount Kilimanjaro and extending from Melinda on the north to Pangani on the south. ——The Missionary Expeditions to Lake Tanganyika continue to be unfortunate. The Algerian Mission at Urundi, near the head of the lake, reports the murder of three of its members and nearly all the missionaries of the London Missionary Society on the west shore of the lake were incapacitated by illness at last accounts.——Herr Flegel has succeeded in ascending the Niger to Gomba, but the boatman refused to go on to Say. He proposed to explore Adamawa in search of the sources of the Binué.——Mr. Stanley succeeded in reaching Stanley Pool in the latter part of July and spent several days there. He confirms the belief expressed by M. de Brazza and the Baptist Missionaries, that the Pool is more than one degree further west than he fixed it in his map. The longitude now given is 15° 47′ west from Greenwich. The country on the north bank of the Congo is reported to be exceedingly healthy.——The *Athenæum* says: "The expedition which the American Board of Commissioners for Foreign Missions, despatched to West Africa a little more than a year ago, appears to have made fair progress. The object is to found an extensive American mission on the Bihé plateau as that field of labor is entirely distinct from those worked by European agencies. The party arrived at Benguela in due course and afterwards took up their abode at Calumbella, twelve miles off, and were delayed there till March 11th, chiefly owing to difficulties about porters, which appear to be as great there as on the eastern side of the continent. Starting at last on the day named, they made what is, for African traveling, a rapid march to Bailunda, accomplishing the two hundred miles in fifteen days. Mr. Bagster and his companions settled here for a month to await the arrival of stores from the coast before moving on to Bihé, some fifty miles distant. In the middle of April it became evident that Mr. Bagster must go to the coast and hurry on matters. He accordingly left his companions at Bailunda to study the Ambunda language and returned to Benguela." Later intelligence informs us of his having

rejoined the party, now settled in camp, some six days march from Bihé. The nights there are cool, the thermometer falling as low as 40° and rising at noon to 85° or 90°. The natives are friendly. The missionaries have made some progress in learning their language.——Dr. Pogge and Lieutenant Wissmann were at Malange at the end of last May, and hoped to arrive at Kimbundo in the latter part of June. They started from Loanda in January and ascended the Kwanza river for some distance.

ARCTIC DISCOVERY.—The Brothers Krause, sent out by the Bremen Society, have visited the Chukchi peninsula at various points and intend spending the winter in the north of Alaska.

Captain Adams, the well known Arctic whaling captain, has this last summer penetrated as far up Wellington Channel as an expedition has ever been. He then steered down Peel Sound to within a short distance of where the *Erebus* and *Terror* were lost. He also visited Beechey Island and the Gulf of Boothia. From an Eskimo near Fury and Hecla Straits, Captain Adams heard a story concerning the death of an officer—possibly Lieutenant Crozier, and two seamen of the Franklin expedition.

Mr. Leigh Smith's vessel, the *Eira*, in which he sailed for Franz Josef Land, has probably been beset by the ice, as she has not been heard from. She was provisioned for fourteen or fifteen months.

The Italian Antarctic Expedition has failed for want of funds. Lieutenant Bove has, however, gone to Buenos Ayres, to explore the coast lands of Patagonia and Eastern Tierra del Fuego for the Argentine Government. He will be accompanied by a number of Italian savants in a separate vessel.

INTERNATIONAL POLAR CONFERENCE.—The Conference was held this year at St. Petersburg. Delegates were present from Denmark, Norway, Sweden, Russia, Austria-Hungary, France and Holland. Polar stations are to be established at Upernavik by Denmark, at Bosskop, Finland, by Norway, at Jan Mayen by Austria-Hungary, at the mouth of the Lena and Novaya Zemlya by Russia and in Spitzbergen by Sweden. Observations are to be begun as soon as possible after August 1, 1882, and continued as far as practicable until September 1, 1883. Meteorological and magnetic phenomena will be observed, hour by hour, and on the 1st and 15th of each month observations will be taken every five minutes during the twenty-four hours, and every twenty seconds during one hour, which will be previously fixed; mean time at Göttingen being adopted in all cases. It was recommended that observations of the temperature of the soil, of evaporation, of terrestrial galvanic currents, of atmospheric electricity, etc., be taken. It was resolved (1) to found, if possible, a special publication to bring more quickly to the knowledge of the scientific world, as well as of the leaders of the various expeditions, the results

achieved from time to time, etc.; (2), to leave behind, where practicable, the buildings and other of the equipments of expeditions likely to be useful to future investigators in the same branches of science, and to take all possible precautions for their preservation; and (3), to endeavor to make arrangement with railway and steamer companies for the reduction of the cost of passages and transport.

GEOGRAPHICAL NEWS.—The second Geographieal Society in the United States has been organized at San Francisco, under the title of The Geographical Society of the Pacific.——The recent census of India, shows the total population to be 252,000,000.——Russian explorers have recently visited the Bai Shan Mountain, twelve miles north-east of Kuldja and found that the fires that have been burning there from time immemorial are not volcanic, but proceed from burning coal. On the sides of the mountain there are caves emitting smoke and sulphurous gas. The question as to the existence of volcanic formations in Central Asia, may now be considered as decided in the negatative.—— The *Nature* states that "Mr. James Jackson, 'Archiviste-Bibliothécairé' of the Paris Geographical Society, has published, in a volume of 340 pages, a 'Liste Provisoire de Bibliographies Géographiques Spéciales.' The list was undertaken at the instance of the Society, and was printed in some haste, we believe, for the recent Venice Congress. But when we remember that the list is only a bibliographical one, a list of lists, in fact, the accumulation of geographical literature is almost appalling. It bears evidence of extensive and careful research, though the author admits that it is by no means exhaustive. Mr. Jackson recently visited the United States to search the libraries there, and the result is a work invaluable to all students of geography. He has wisely devoted comparatively small space to Europe, because, as he states, the works relating to the countries of that continent are well known and easily accessible. Mr. Jackson gives not only bibliographies proper, but references to works on travel and geography, and to periodicals, journals, and transactions, which contain special lists. The divisions of the list are:— Europe, Asia, Africa, America, Oceanica, Polar regions, Oceans and Hydrography, Peoples and Nations, Voyages, Travelers, and Geographers, and Generalities. By means of the arrangement under each division the methodical table of contents, the index to authors and periodical publications, the work is rendered easily consultable. It reflects the greatest credit on Mr. Jackson's industry and on the enterprise of the Paris Society."——A new island has been discovered in lat. 7° 48′ S, long. 82° 48′ W. and 188 miles from Punta Aguja, south of Guayaquil, the nearest land. It appears to be of volcanic origin and is only fifty feet above the sea, in its highest part. It is a mile long and about the same width.——In the northern portion of the Chinese pro-

vince of Shensi the sand from the desert is seriously encroaching on the country and has already half buried some cities. The high walls which have hitherto kept it out of Yülin will not much longer be of any avail, as the sand is already heaped almost to the top.——An expedition was sent last summer to explore the neighborhood of Bear Lake, British Columbia, which was previously quite unknown.——In the Geographical Section at the Meeting of the British Association, in addition to the papers heretofore mentioned the following were read:—Progress of Arctic Research since the Foundation of the British Association, by Clements R. Markham, F. R. S; On the Island of Socotra, by Professor J. Bailey Balfour; Journey to the Imperial Mausolea, East of Peking, by F. S. A. Bourne; Comparative Sketch of what was known of Africa in 1830, with what is known in 1881, by Lieutenant Col. J. A. Grant; Some Results of Fifty Year's Exploration in Africa, by the Rev. Horace Waller; Recent Visit to the Gold Mines of the West Coast of Africa, by Commander V. L. Cameron, R. N.

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SCIENTIFIC NEWS.

— The first part of a valuable work by M. Alph. Milne Edwards, on "The Fauna of Austral Regions," has been presented to the French Academy. The geographical distribution of birds is chiefly dealt with. It is remarkable (and would hardly have been expected) that these animals are eminently adapted to reveal the existence and position of the zoölogical centers whence the various species have radiated. The penguins are specially interesting in this respect. They appear to have migrated from a center of production in the Antarctic islands, near Victoria land, and to have followed the great currents going northwards, reaching the waters of Cape Horn, the Falklands, New Georgia, the Cape of Good Hope, and various islands of the Indian ocean, establishing, in each case, powerful colonies, with (in time) distinctive characters. Another colony, represented by the Spheniscans, starting from the same center, and favored by Humboldt's current, has gone to the west of Cape Horn, along the coast of Chili, to Peru and the Gallipagos islands, touching at various points.

— The volume on the Vertebrata of the Western Tertiary formations on which Professor Cope has been engaged for several years, is, we understand, approaching completion. Most of the plates are drawn, and the printing of the text is well advanced. This work will cover much ground, and will furnish much detailed information on a subject which has of later times excited general interest. The volume is No. IV of the Hayden series. Vol. III will follow. It will give a similar account of the recent discover-

ies in the Permian and Mesozoic formations of the West. Nearly a thousand species of Vertebrata will be described and figured in these volumes. The Hayden series, when completed, will form a monument to Dr. Hayden, who projected it, and will reflect credit on the Government, which has sustained the publication.

— Among recent publications of the Census Bureau is an extra Census Bulletin containing tables showing the approximate areas of the United States, the several States, and their counties. It has been prepared by Mr. Henry Gannett, the geographer and special agent of the tenth census. It appears that of several States a number of estimates of area have been in use, differing from one another by thousands of square miles, and none of them perhaps traceable to any authentic source; while many of the results are palpably wrong, being so far from the truth that it is a source of surprise that they were not corrected before. A map defining the gross areas of the States and Territories accompanies this useful Bulletin.

— Mr. Allen Whitman, a native of East Bridgewater, Mass., died recently in St. Paul, Minnesota, aged 45 years. He was a graduate of Harvard, and while one of the best classical scholars in the country, was one of the most valuable assistants in the U. S. Entomological Commission, having previous to the organization of the Commission, published two valuable reports on the locust as it appeared in Minnesota.

— The University of Cambridge, England, has conferred the honorary degree of Doctor of Laws upon Professor Thomas Sterry Hunt, LL.D., F.R.S., a native of Connecticut, who was for twenty-five years chemist and mineralogist to the Geological Survey of Canada, and resigned that post in 1872 to accept the Chair of Geology in the Massachusetts Institute of Technology.

— Professor W. N. Rice, and Mr. H. L Osborn, in their report as curators of the Museum of Wesleyan University, gives a review of the state of the museum. Many important additions have been made, and the spirit and zeal shown by the curators should result in such pecuniary benefactions as would liberally endow that department.

— An autobiographical sketch by Rev. Titus Coan, entitled, "Life in Hawaii," is announced by A. D. F. Randolph & Co. It includes accounts of the eruptions of the volcanoes in the Hawaiian Islands, of which this missionary has been a diligent historian since 1835.

— The late John Amory Lowell bequeathed $20,000 to Harvard College, for the botanical garden, on condition that it be called the "Lowell Botanic Garden," in memory of his grand-

father, who started the first subscription for the purpose of establishing this department.

— Mr. G. H. Darwin in his work on the tidal evolution of the moon has drawn the inference that geological denudation and deposition must have been vastly more active in former times than at present.

— Mr. C. S. Nachet, the founder of the well-known French firm of microscope manufacturers, died October 28, at the advanced age of 83.

— The Census Bulletin, No. 270, refers to the production of iron ore in the United States, which was 7,971,706 tons; with a valuation of $23,167,007.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

MIDDLESEX INSTITUTE, Oct. 12, 1881.—The President, L. L. Dame, read a paper on "Botanical Nomenclature," in the course of which he alluded to the different pronunciations prevailing even among good botanists, and advocated, subjecting all names becoming Latinized to the Latin rules of prounciation without regard to the vernacular as the only way of ensuring absolute uniformity. In the discussion which followed it was objected that under such an arbitrary rule many names derived from persons would become so disguised as to be practically lost, thus defeating the object for which they were established. But how far this objection may prevail against the unquestionable advantages of a uniform pronunciation is an open question. The paper was, however, the most important in its bearings of any yet presented to the Institute, and well calculated to set the members to thinking in the right direction. A new by-law providing for the formation of sections was adopted, and the completion of arrangements for a course of lectures announced. Prof. Edward S. Morse, and Rev. Edwin C. Bolles, D. D., of Salem; Prof. John Fiske and Prof. Wm. H. Niles, of Cambridge, Mass.; and Prof. Chas. A. Young, of Princeton, New Jersey, were elected honorary members.

NEW YORK ACADEMY OF SCIENCES, Nov. 14.—Dr. A. A. Julien read a paper on the excavation of the bed of the Kaaterskill, N. Y.

Nov. 21.—Dr. Louis Elsberg remarked on the cell-doctrine and the bioplasson doctrine.

Nov. 28.—Commander Cheyne, R. N., delivered a lecture entitled, "The Discovery of the North Pole practicable."

Dec. 5.—Dr. A. A. Julien read a paper on the volcanic tufas of Challis, Idaho.

Boston Society of Natural History, Nov. 16.—Mr. William Trelease compared the glands of plants with those of animals. He described the histology and showed the homology of the organs in question. The glands are anomalous in that a deeply lying tissue secretes the fluid, which reaches the exterior through a distinct break in the epidermis—not a stoma. The secreting tissue is the end of a fibro-vascular bundle, the cambium having produced the active cells, instead of wood cells, the whole being surrounded by a thin bast sheath. He described a number of cases showing the glands to represent undeveloped flowers, as previously indicated by Delpino. Professor D. P. Penhallow then read a paper on the temperature of trees.

Dec. 7.—Professor A. Hyatt described the sponge found in the Boston Water Supply, and Mr. B. H. Van Vleck discussed its distribution in Farm Pond, and the general condition of the latter; Dr. Wm. F. Whitney showed a skull of an ancient Mexican, with an arrow-head imbedded in the superior nasal fossa.

American Geographical Society, New York, Nov. 25.—Dr. I. I. Hayes[1] delivered a lecture on the water-ways of New York, considered in relation to the transportation interests of the State, and the commerce of the city.

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SELECTED ARTICLES IN SCIENTIFIC SERIALS.

American Journal of Science, Dec.—Lower Silurian fossils (Graptolites) in Northern Maine, by W. W. Dodge. A contribution to Croll's theory of secular climatal changes, by W. J. McGee. On the relation of the so-called "Kames" of the Connecticut River valley to the Terrace formation, by J. D. Dana.

Geological Magazine, Nov.—Evaporation and eccentricity as co-factors in glacial periods, by E. Hill. The valley system of S. E. England, by S. V. Wood. Sudden extinction of the Mammoth, by C. Reid.

Annales des Sciences Naturelles, Sept., 1881.—Observations on the development and organization of the Proscolex of *Bilharzia hæmatobia*, by J. Chatin. Observations on the sexual cells of Hydroids, by A. Weismann. Observations on the functions of the caudal appendage of Limuli, by J. de Bellesme. Rare or new Crustacea of the coast of France, by M. Hesse. Observations on the encystment of *Trichina spiralis*, by J. Chatin.

Zeitschrift für Wissenschaftliche Zoologie, Nov. 1.—On the developmental history of the ophiuran skeleton, by H. Ludwig. Contributions to the anatomy and histology of *Sipunculus nudus*, by J. Andreæ. Comparative anatomical studies on the brain of bony fishes, with especial reference to the Cyprinoids, by P. Mayser.

[1] Since suddenly deceased, Dec 17.